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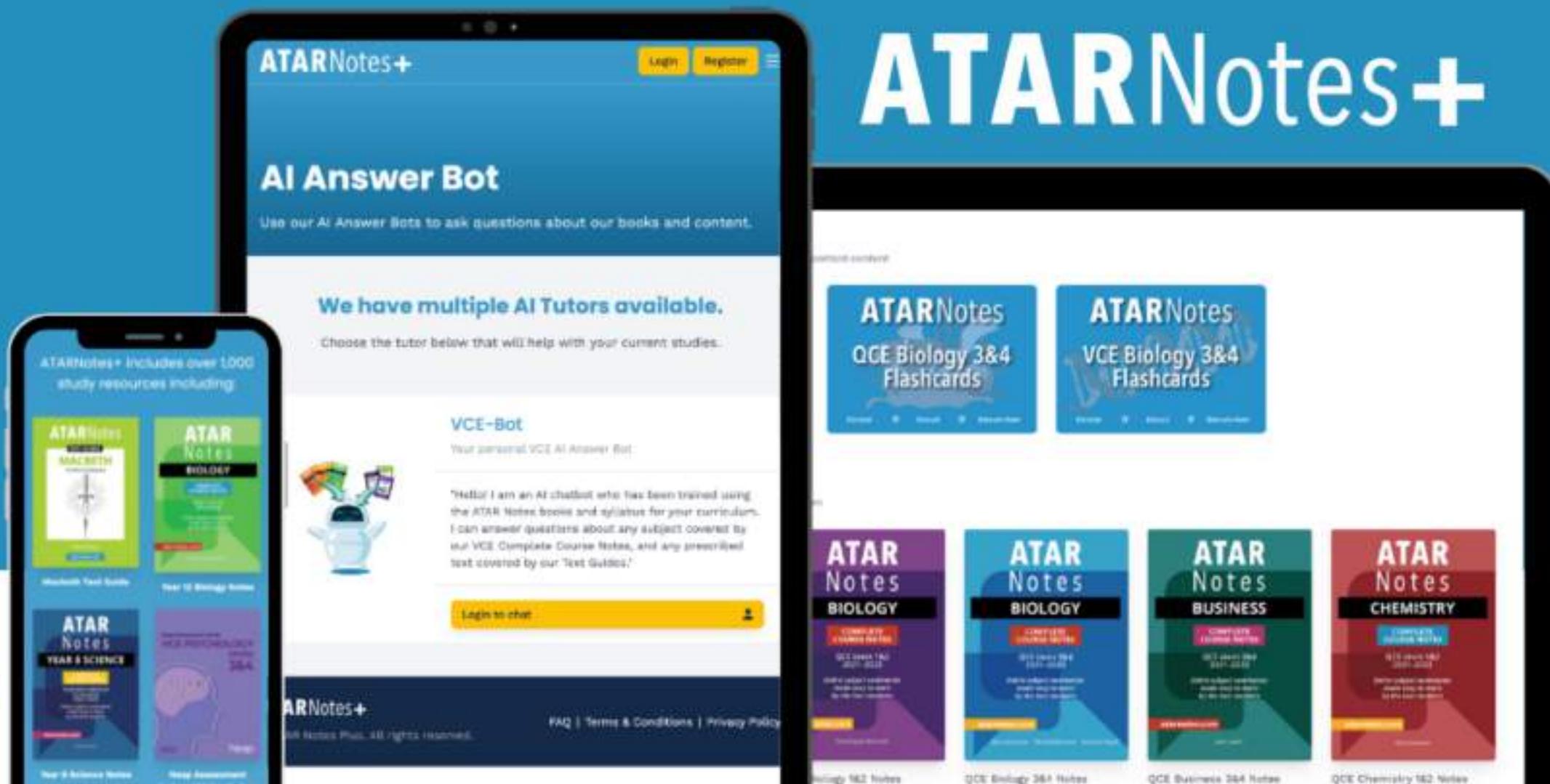
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ATARNotes

VCE Biology 1&2

ATARNotes January Lecture Series

Presented by:
Angelica

Welcome!!

Topics to be covered

- **AOS1:**

- cells
- organelles
- plasma membrane
- cell cycle

- **AOS2:**

- plant vascular systems
- animal systems
 - digestive
 - endocrine
 - excretory
- homeostasis

Ask your questions throughout the lecture; I'll be answering in the live chat ! 😊

Who am I?

- Angelica
- Writer & medical student
- Graduated high school in 2019: 49 Biology, 47 English, 40 PE, ATAR: 97.25
- 2020-2022: Bachelor of Biomedical Science, Monash
- 2023: Bachelor of Medical Science and Doctor of Medicine (MD), Monash
- Have two cats and a dog
- Ran a virtual half marathon

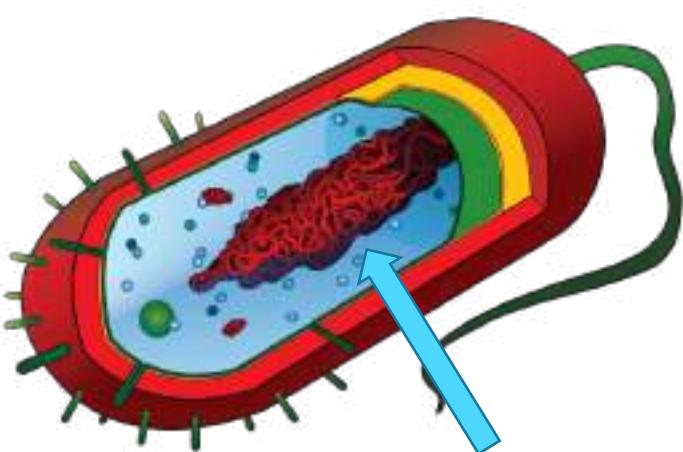


Cell Structure + Function

Prokaryotes vs Eukaryotes

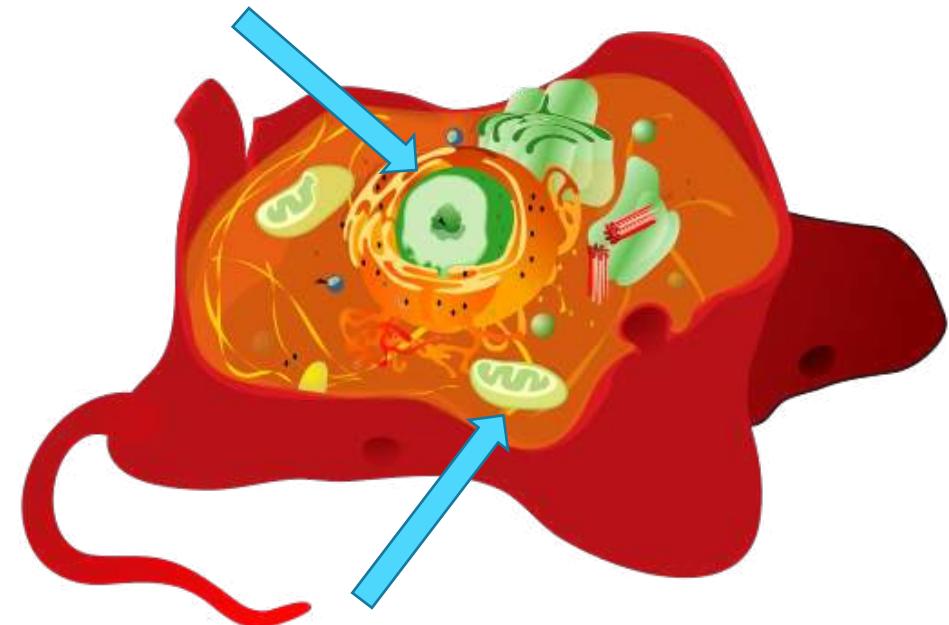
- **Prokaryotes:**

- No membrane bound nucleus
- No membrane bound organelles
- Not capable of true multicellularity
- Reproduce via binary fission



- **Eukaryotes:**

- Membrane bound nucleus
- Membrane bound organelles
- Reproduce via mitosis and meiosis



Cell Structure + Function

Organelles



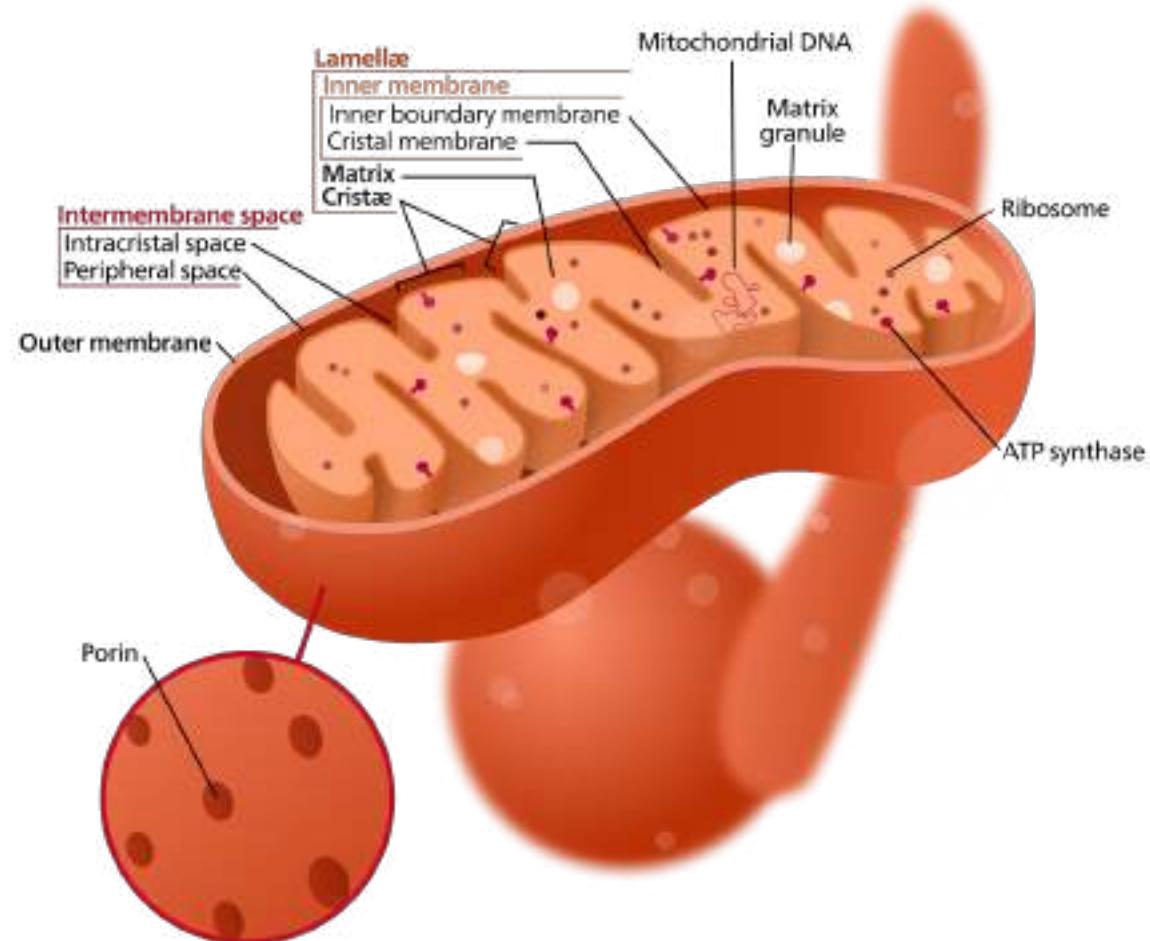
Cell Structure + Function

Organelle Summary

ORGANELLE	FUNCTION
Nucleus	Contains the genetic information of the cell as DNA -double membrane that is porous
Ribosome	Site of translation (protein synthesis) -made of rRNA-not membrane bound
Rough endoplasmic reticulum	-has ribosomes attached -transports and modifies proteins
Smooth endoplasmic reticulum	-no ribosomes -synthesis of steroid molecules
Golgi apparatus	-modifies and packages proteins into vesicles for export from the cell
Lysosomes	Vesicles containing enzymes that break down debris and unwanted molecules in the cell
Mitochondria	Site of ATP production/aerobic respiration
Chloroplast	Site of photosynthesis

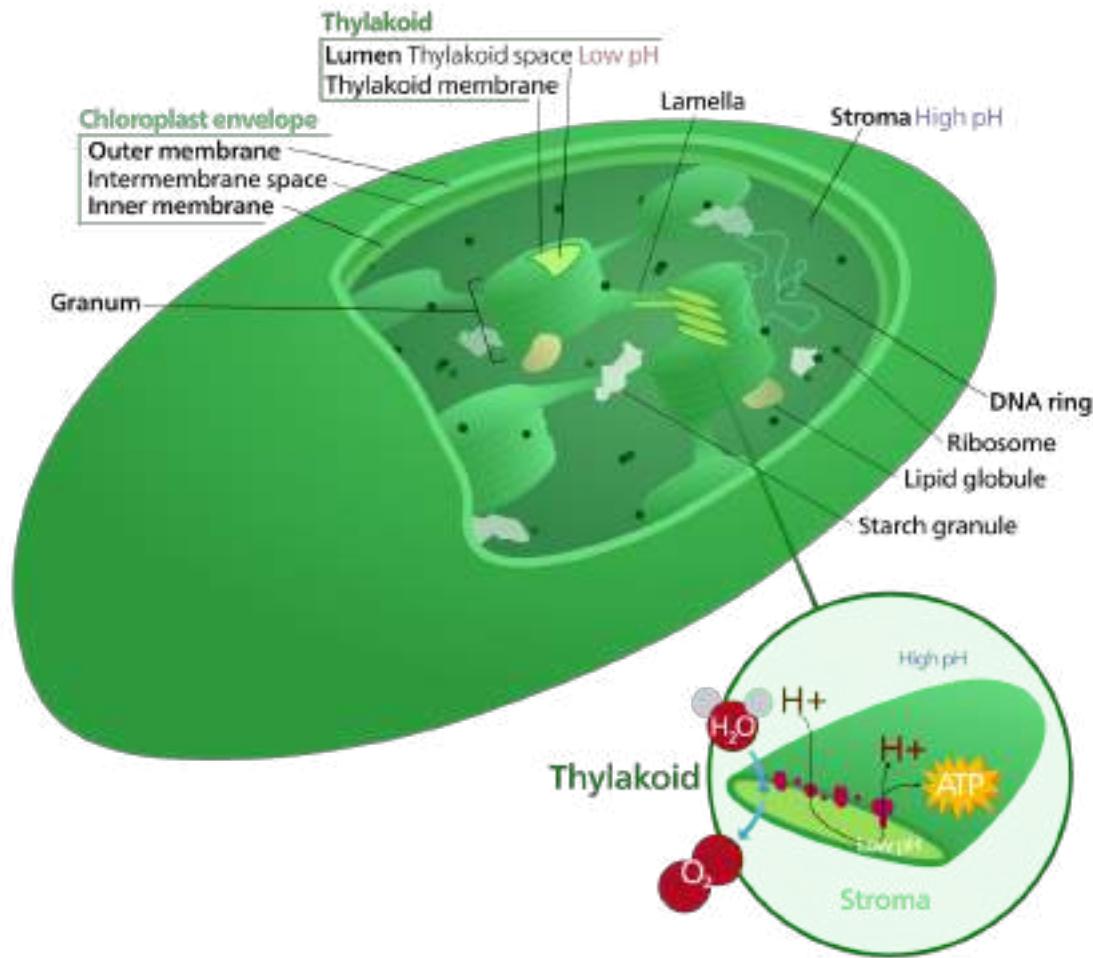
Cell Structure + Function

Mitochondria



Cell Structure + Function

Chloroplast



- **Hydrophilic molecules:**

- Note: the suffix ‘-philic’ means ‘to like’, whilst the prefix ‘hydro-’ refers to water
- Able to dissolve in water
- Also called **lipophobic** or **polar**
- e.g. proteins

- **Hydrophobic molecules:**

- Note: the suffix ‘-phobic’ means ‘to dislike’, whilst the prefix ‘hydro-’ refers to water
- Will not dissolve in water
- Will interact with other hydrophobic molecules
- Also called **lipophilic** or **non-polar**
- e.g. oils, fats

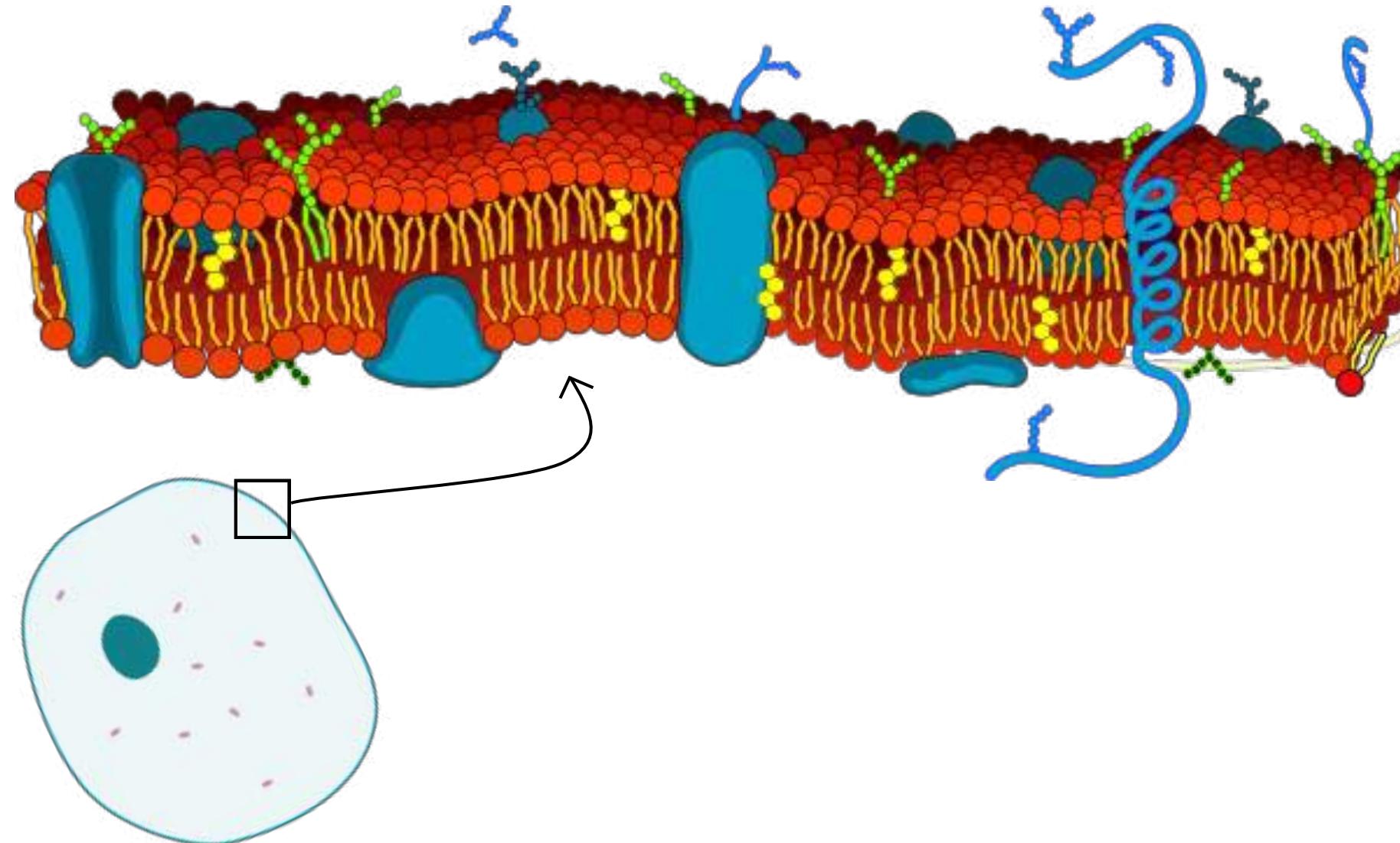
Cell Structure + Function

Think: Water + Oil

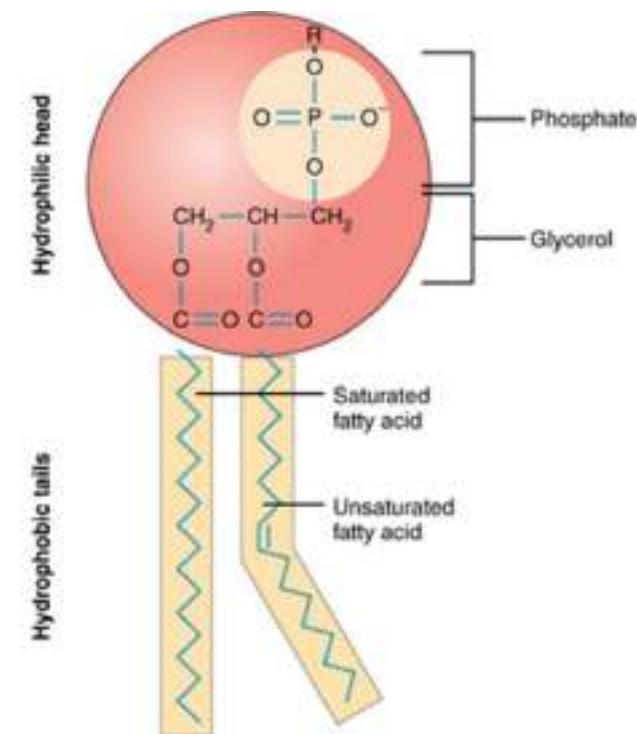
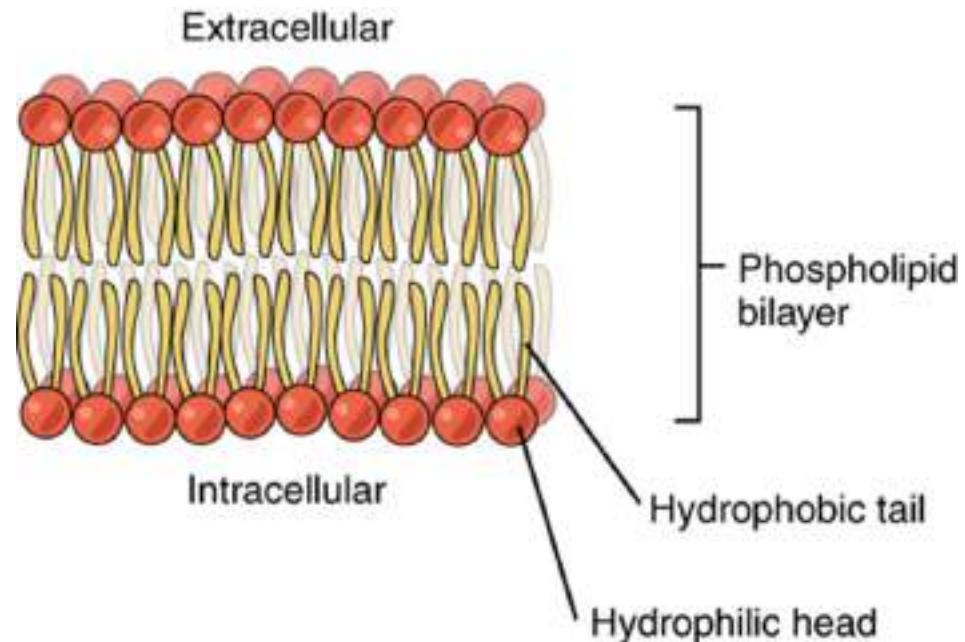


Cell Structure + Function

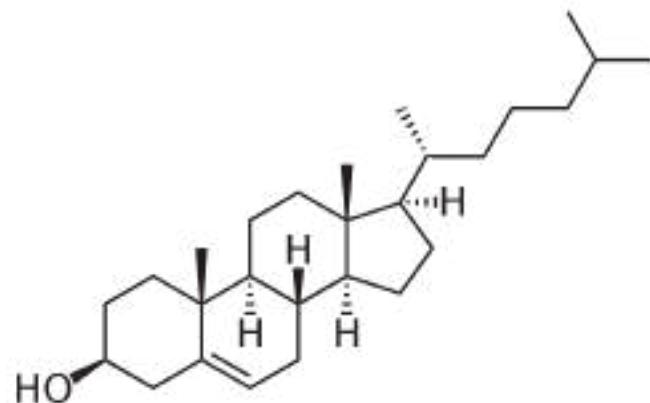
The Plasma Membrane



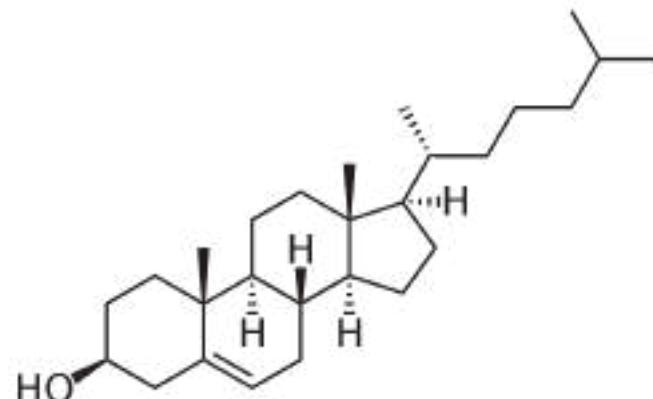
- Phospholipids are **amphipathic** – they have a hydrophilic head (phosphate + glycerol) and two hydrophobic fatty acid tails



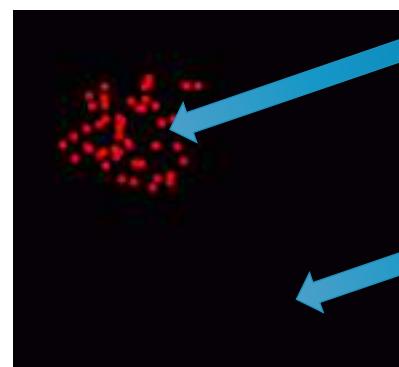
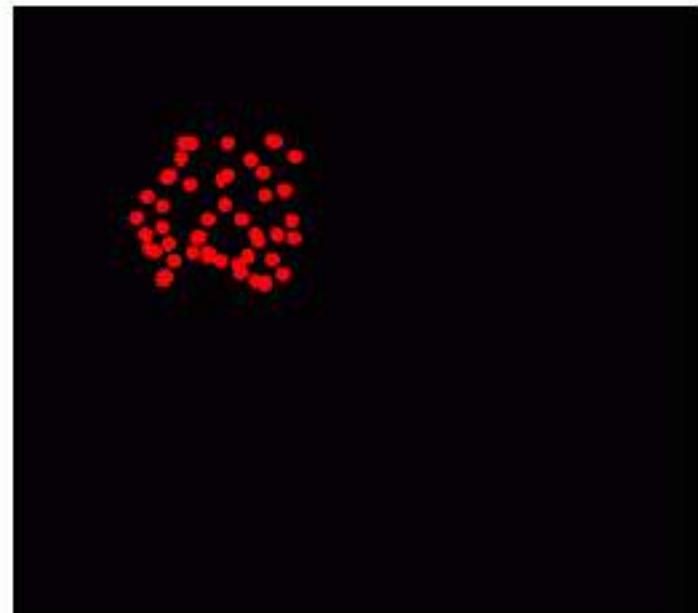
- Function 1: to prevent the phospholipids from aggregating and solidifying, thus maintaining the fluidity of the membrane



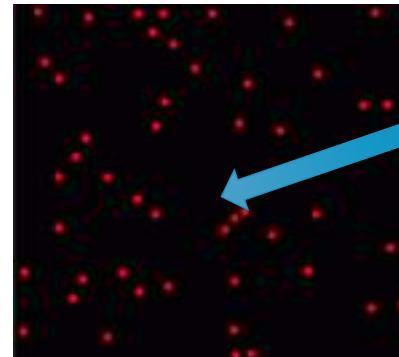
- Function 2: maintains the integrity of the membrane by **preventing the phospholipids from separating** entirely, acting as a 'glue' component



- **Diffusion:** the passive, net movement of molecules from a region of high concentration to low concentration



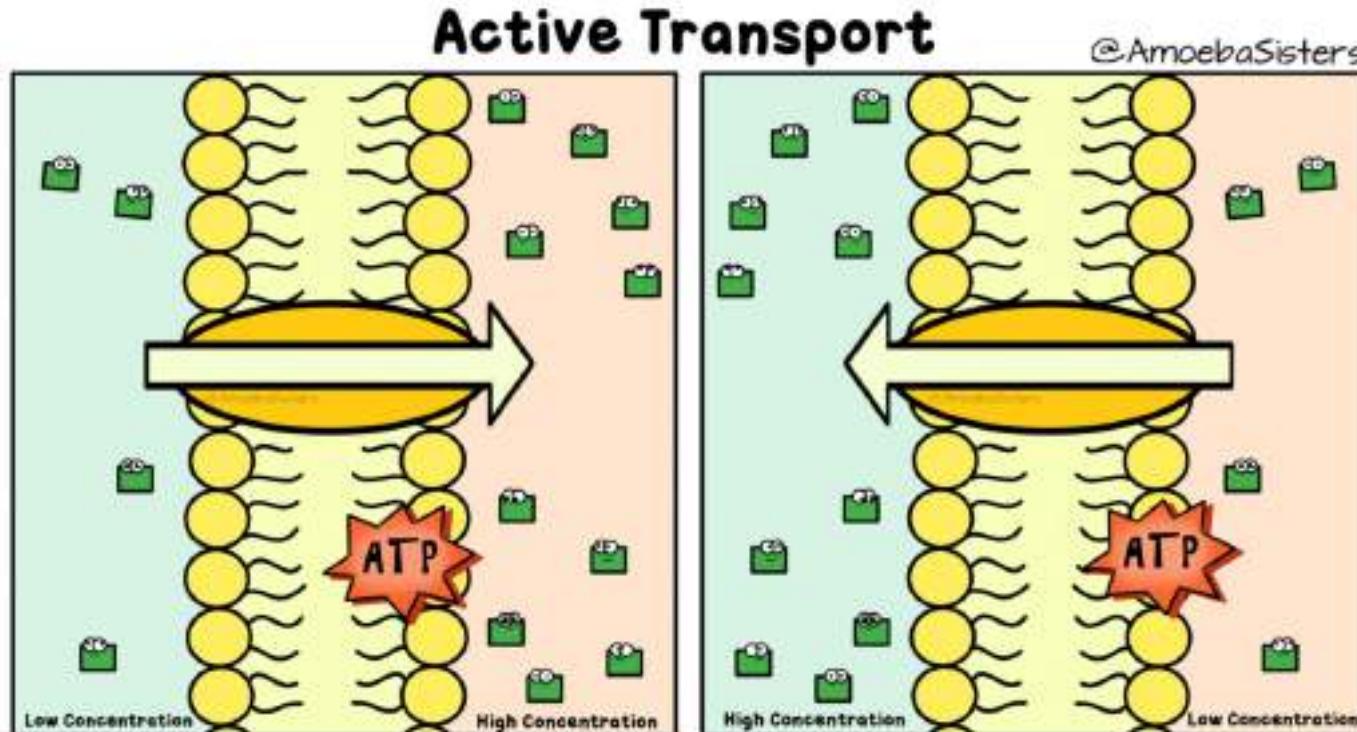
High Concentration
Low Concentration



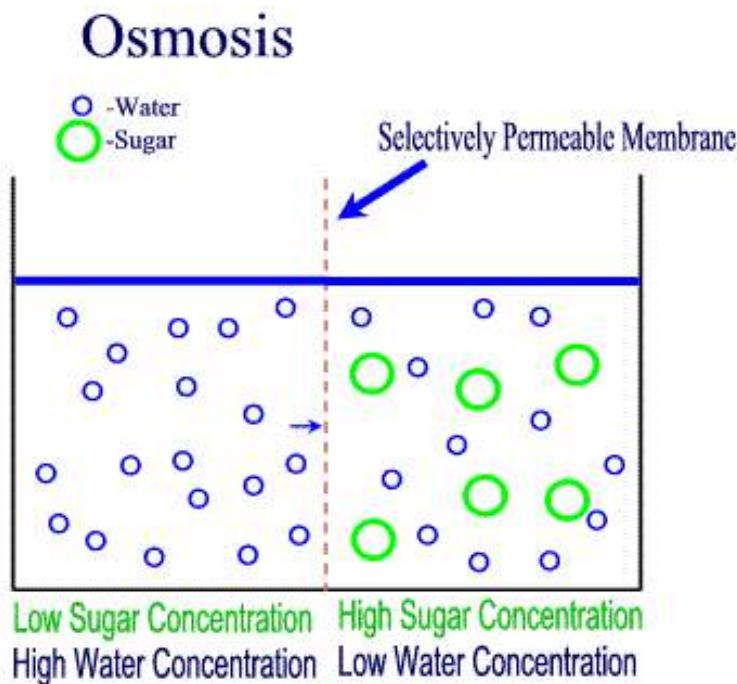
Equilibrium

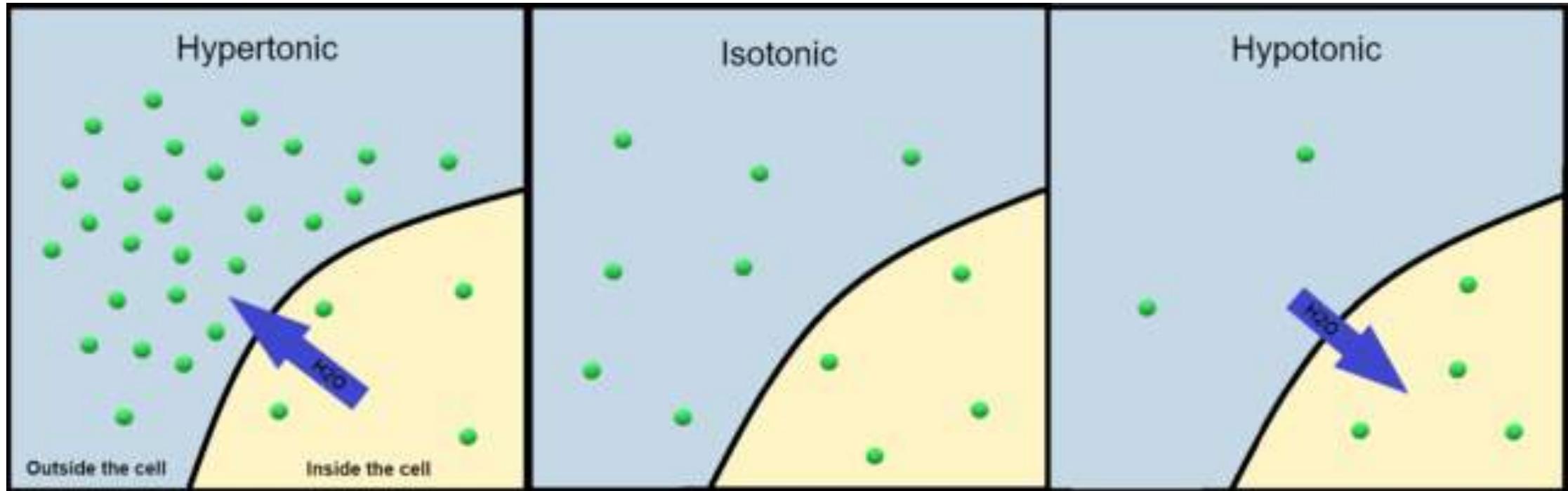
- Diffusion: the passive, net movement of molecules from a region of **high** concentration to **low** concentration
 - **Simple diffusion:** diffusion *directly through* the lipid bilayer
 - Hydrophobic substances (alcohol, steroids, etc.)
 - Very small uncharged molecules (water, oxygen, carbon dioxide, etc.)
 - **Facilitated diffusion:** the passive, net movement of molecules across the plasma membrane via transport proteins
 - Large hydrophilic molecules (glucose, amino acids, etc.)
 - Charged molecules (Na^+ , Ca^{2+} , etc.)

- **Active Transport:** active movement of molecules across the plasma membrane *against* a concentration gradient
 - Requires ATP



- **Osmosis:** the *net movement* of water molecules across a semi-permeable membrane from a region of *high water* concentration to a region of *low water* concentration



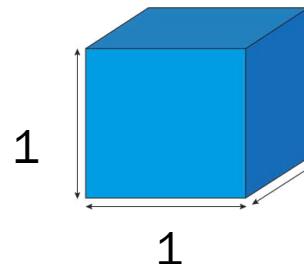


Cell Structure + Function

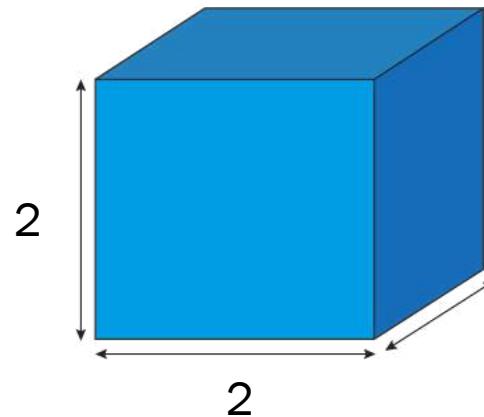
Total Surface Area = area of each side

Area of a Square = L^2

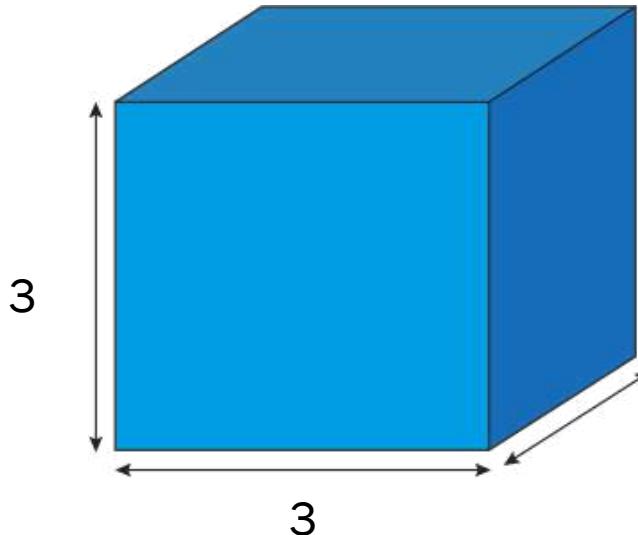
Volume of a Cube = L^3



Side Length = 1	
Total Surface Area	6
Volume	1
SA : V	6 : 1



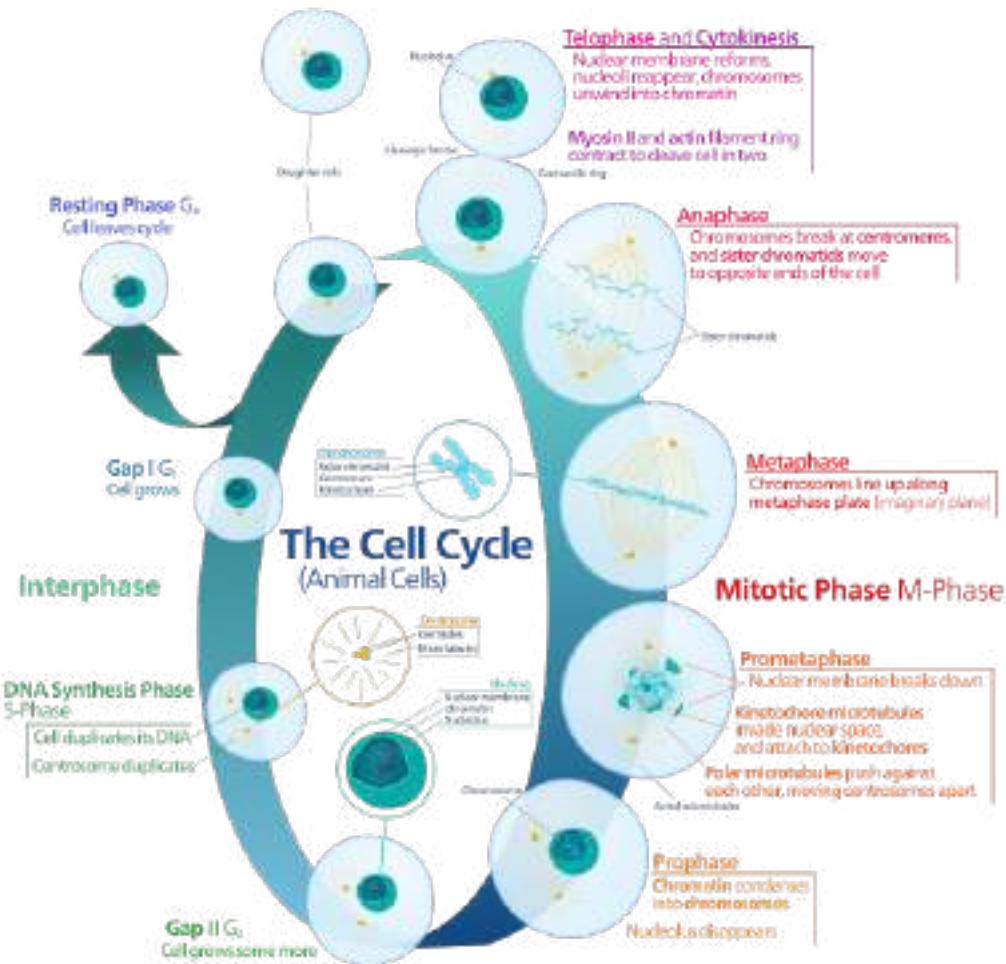
Side Length = 2	
Total Surface Area	24
Volume	8
SA : V	24 : 8 (3 : 1)



Side Length = 3	
Total Surface Area	54
Volume	27
SA : V	54 : 27 (2 : 1)

Cell Cycle

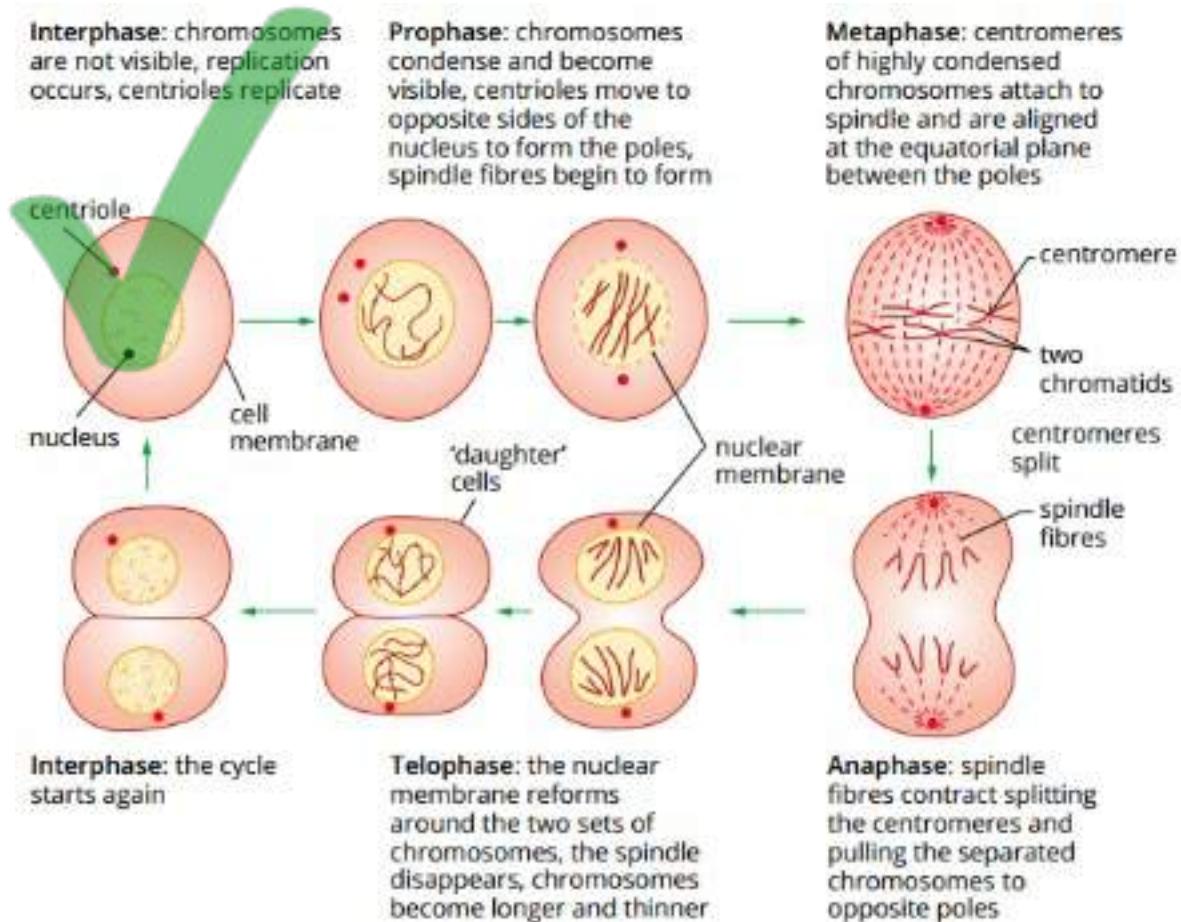
Eukaryotic Cell Cycle



Cell Cycle

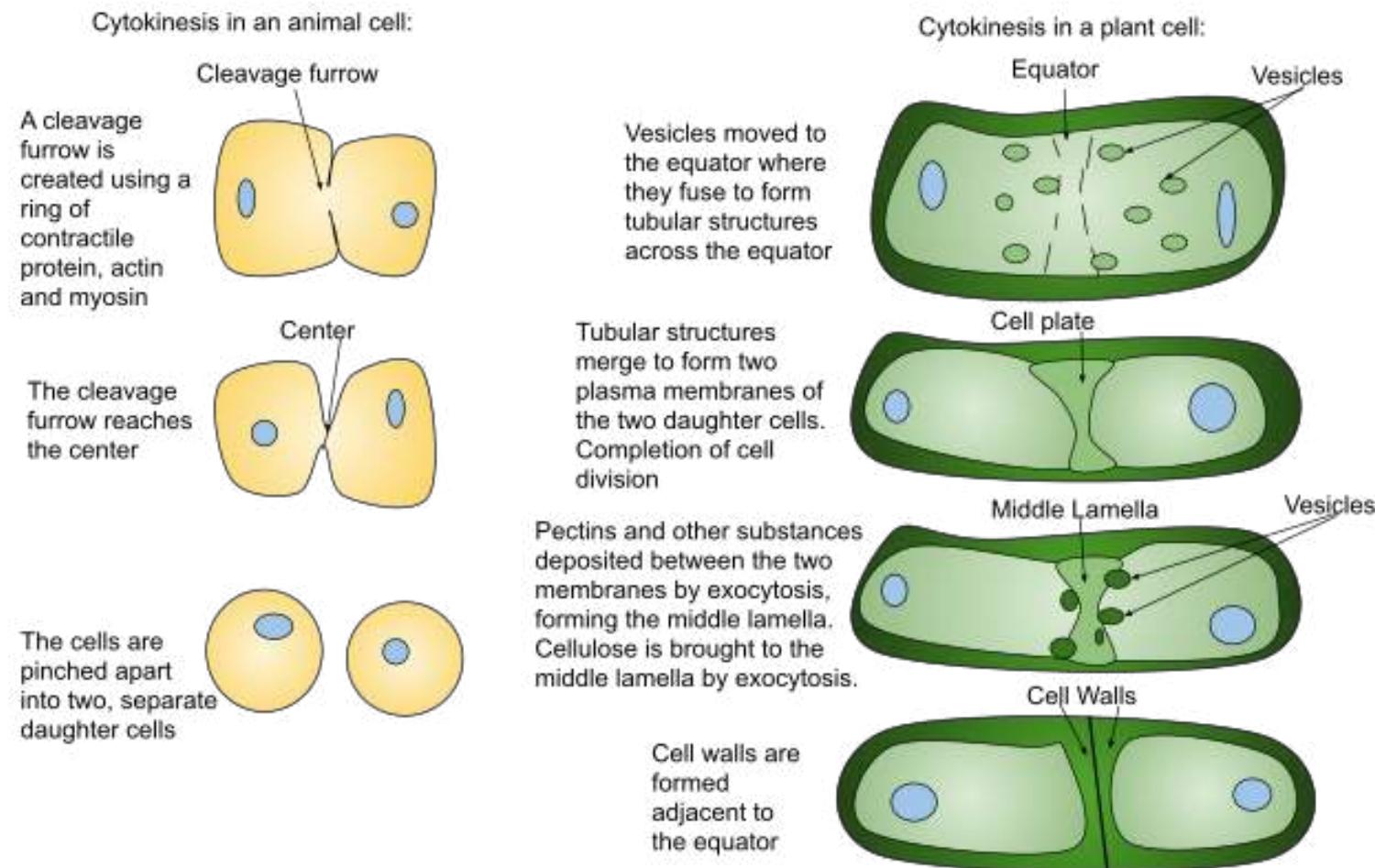
Mitosis

P M A T



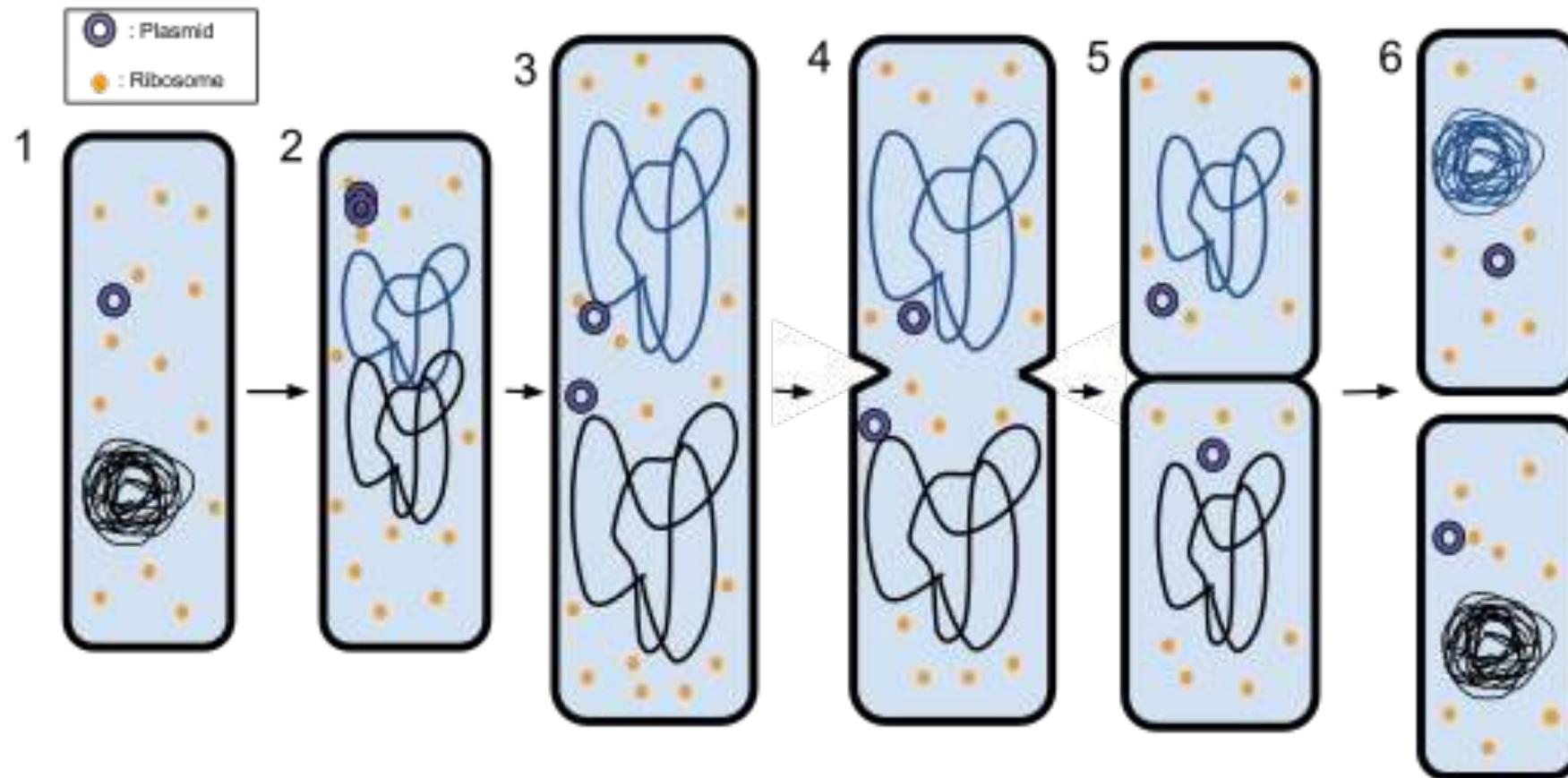
Cell Cycle

Cytokinesis



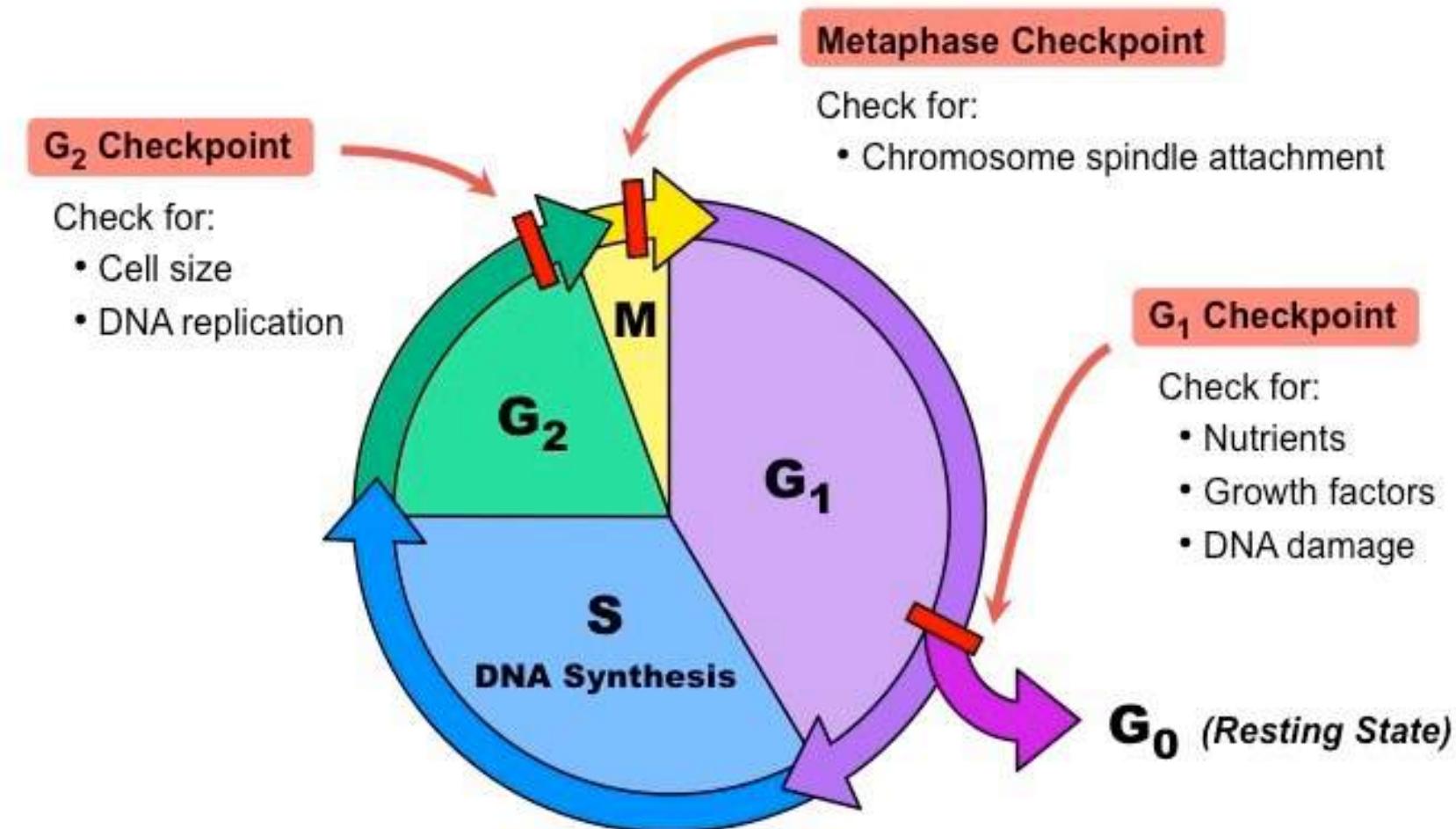
Cell Cycle

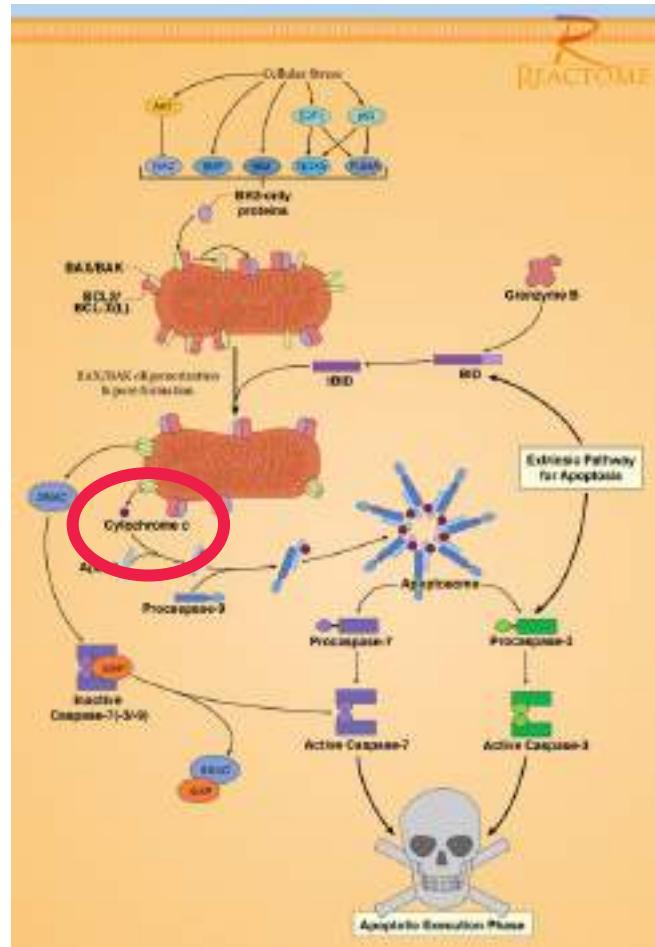
Binary Fission



Cell Cycle

Eukaryotic Cell Cycle



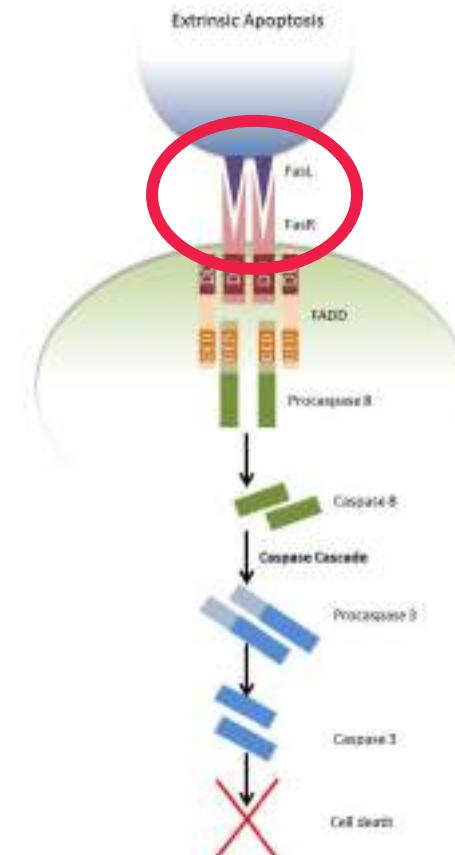


- **Intrinsic**

- **mitochondrial pathway**
- cell damage, including radiation, damaged DNA etc.

- **Extrinsic**

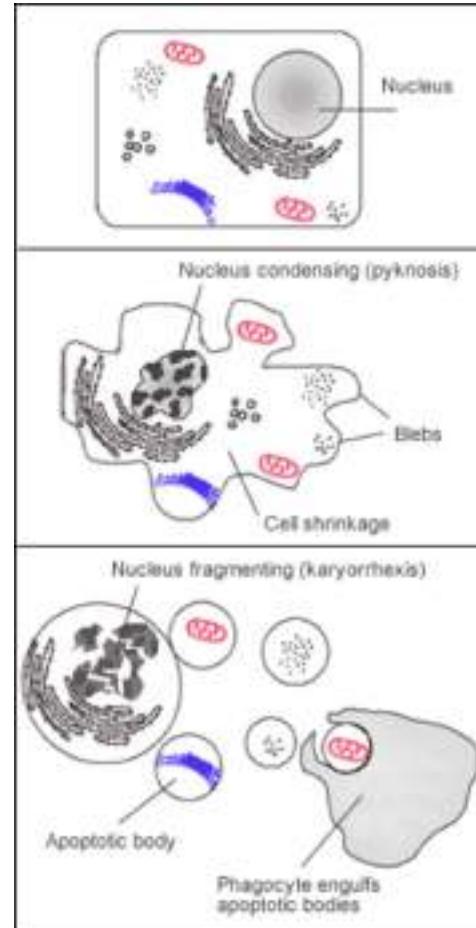
- death receptor pathway
- extracellular causes, such as changed conditions in extracellular fluid, infection etc.



Cell Cycle

Apoptosis

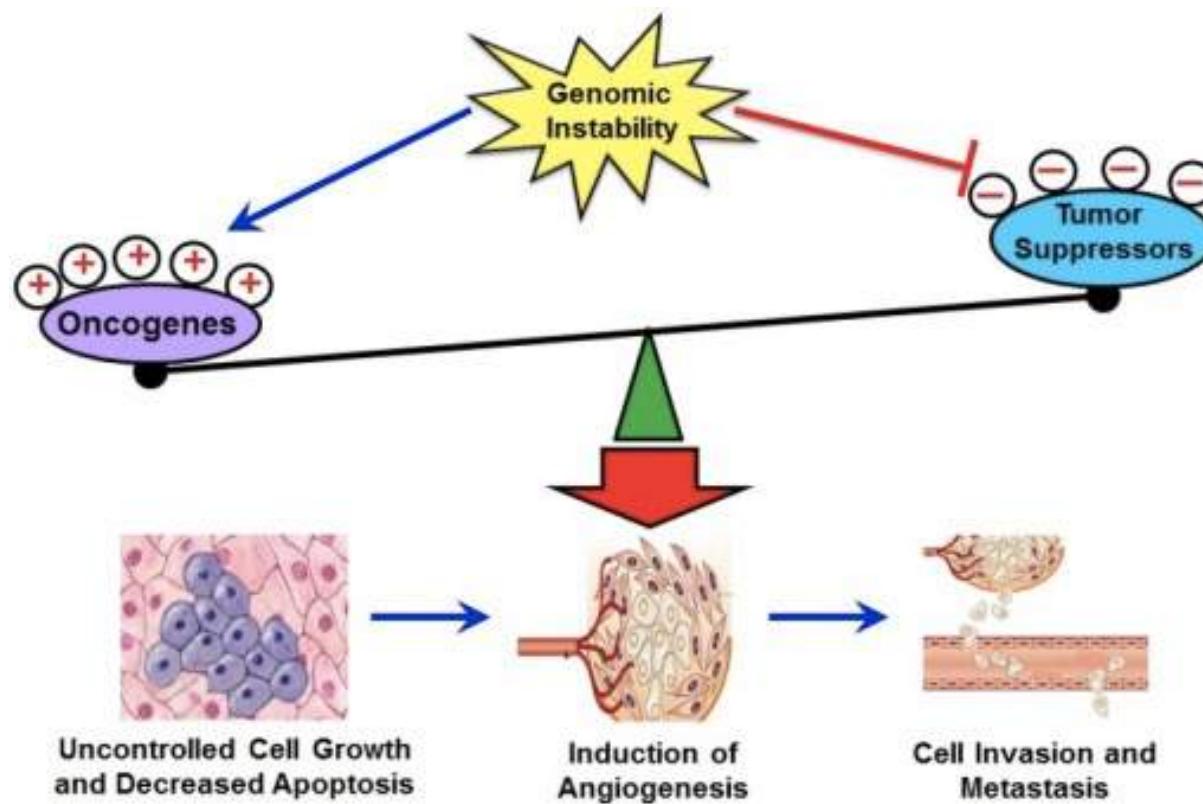
1. Activation of **caspases** is initiated
2. These caspases activate other caspases (**caspase cascade**)
3. These final caspases breakdown the cell's cytoskeleton as well as proteins in the nuclear membrane and Golgi apparatus
4. The cell shrinks and forms **blebs**
5. The cell breakdown into vesicles containing digested cell contents (**apoptotic bodies**)
6. Phagocytes are signalled to the site of apoptosis and they phagocytose the apoptotic bodies (prevents inflammation)



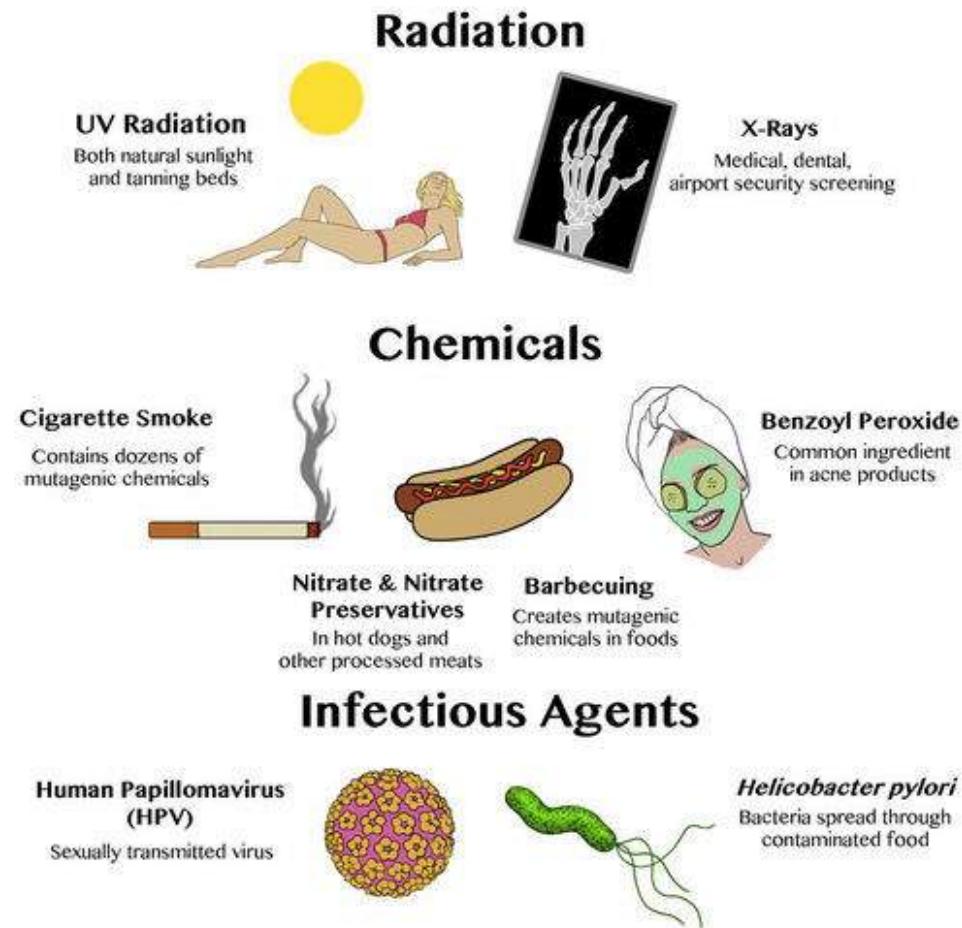
- Excess mitosis can lead to neoplasms
- **Benign** – localised masses
- **Potentially malignant** – localised masses that will eventually invade other tissues and transform into cancer
- **Malignant** (cancer) – masses that invade other tissues

Cell Cycle

Oncogenes + Tumour Suppressor Genes



- What are mutagens?



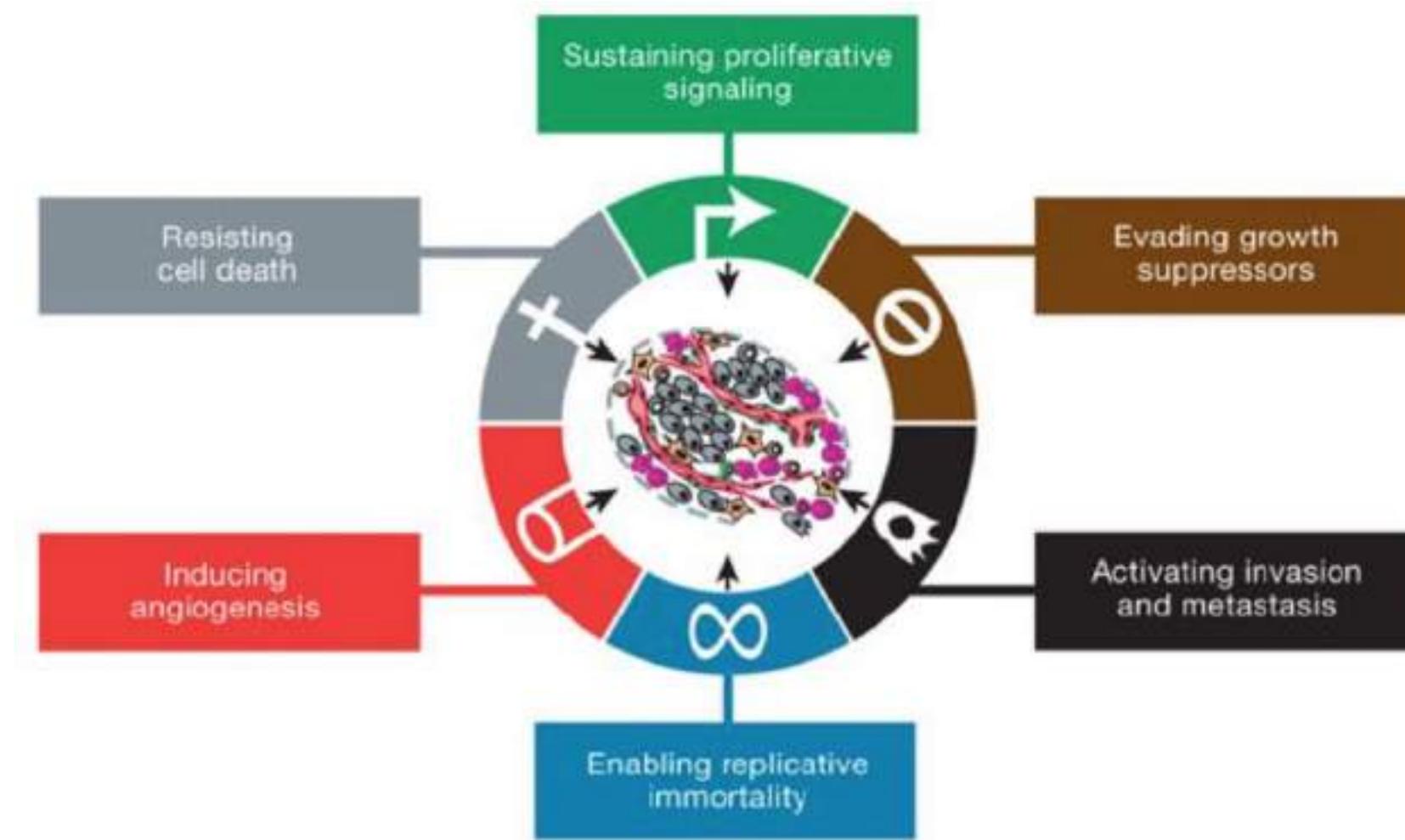
- **Mutagens** are factors which cause mutations in DNA (not to be confused with *mitogens*)
- **Carcinogens** (a mutagen which effects TSGs or proto-oncogenes) include:
 - **Chemical** factors: cigarette smoke
 - **Physical** factors: ionising radiation in X-rays
 - **Biological** factors: HPV and cervical cancer



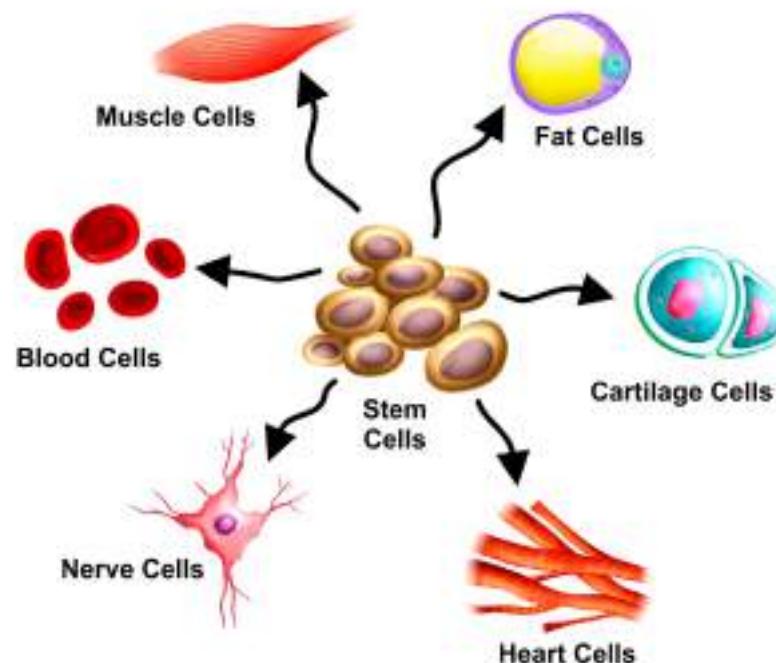
- **Loss of immunity:** immunocompromised individuals may be unable to detect and destroy neoplasms
- This can lead to the progression of malignant tumours, which would otherwise be eliminated in a healthy individual

Cell Cycle

Hallmarks of Cancer

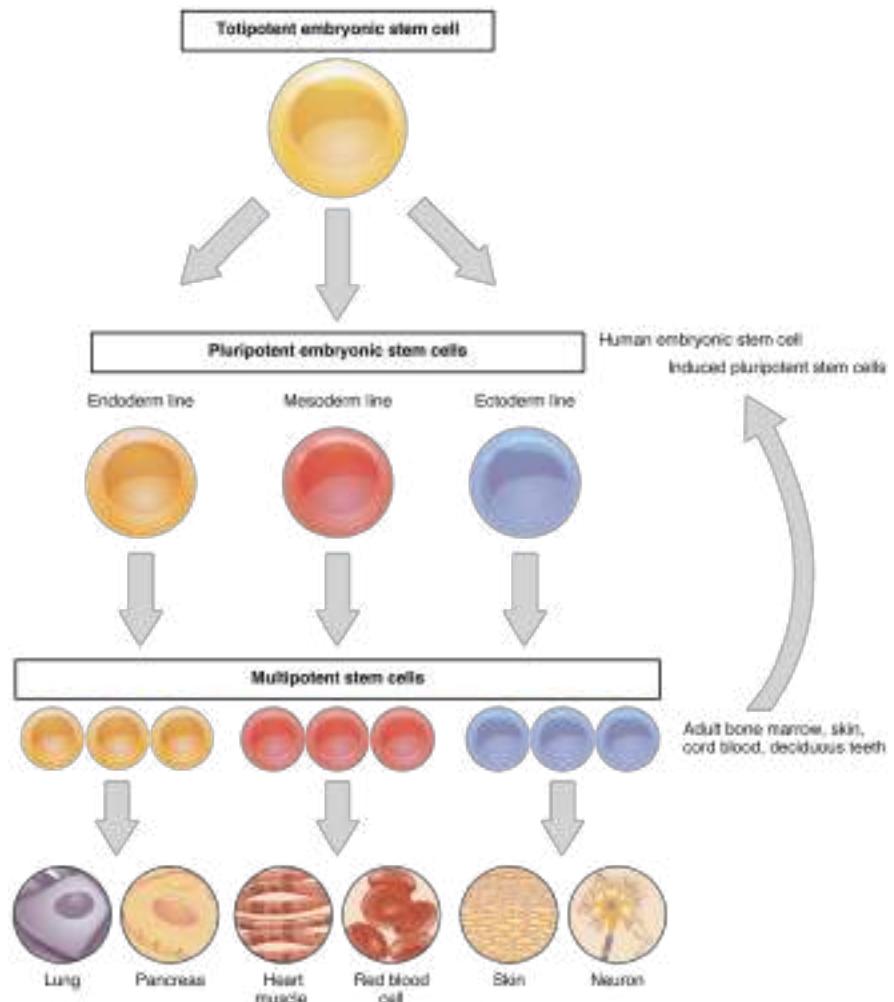


A cell that is not yet differentiated and has the potential to develop into different specialised cell types



Cell Cycle

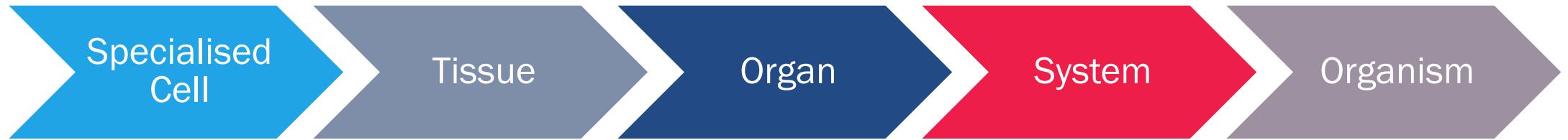
Stem Cell Totipotency



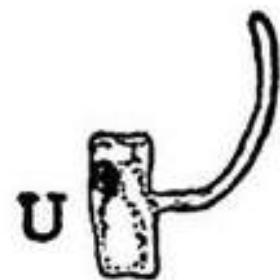
- *Embryonic stem cells* are totipotent or pluripotent. They can be obtained from IVF programs and can replicate indefinitely.
- *Adult stem cells* are multipotent or unipotent. They function to repair and regenerate damaged and aged tissues. Cannot replicate indefinitely.

Plant Systems

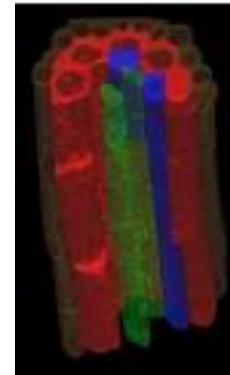
Levels of Cellular Organisation



Root hair cells



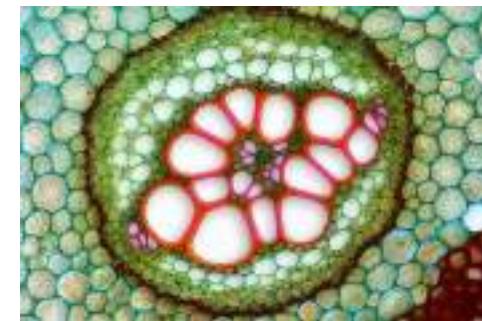
Root tissue



Roots



Vascular bundles
make up vascular system



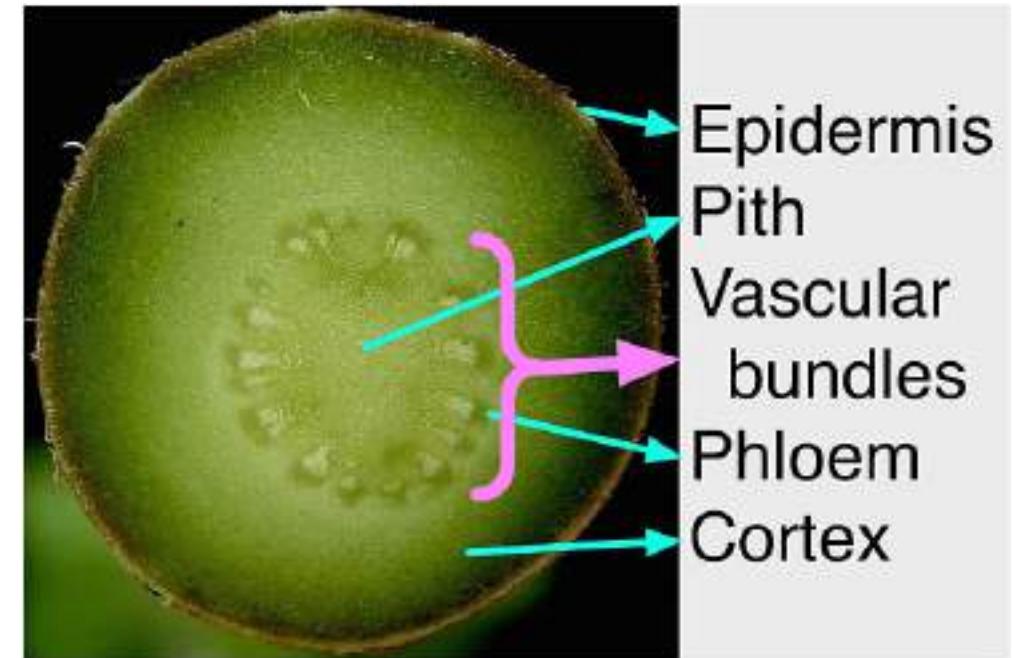
Plants



Plant Systems

What are Vascular Plants?

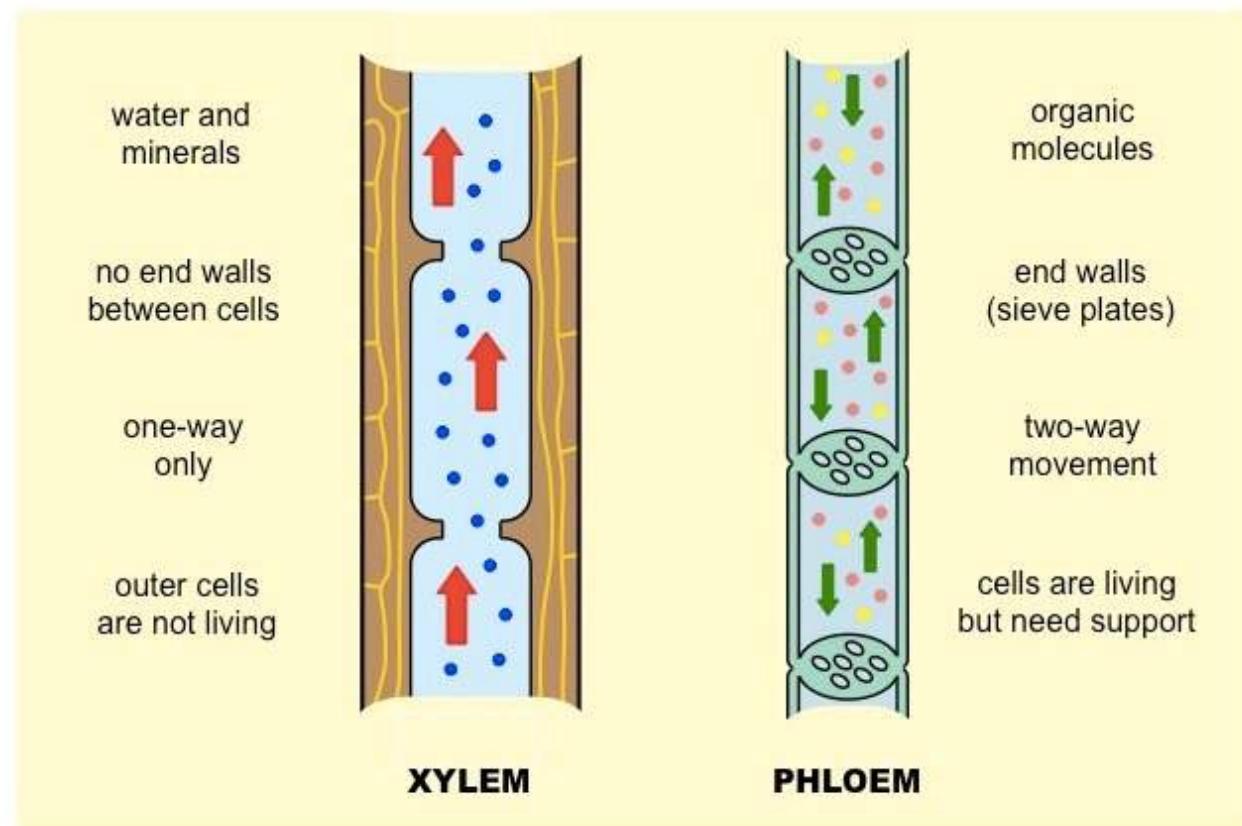
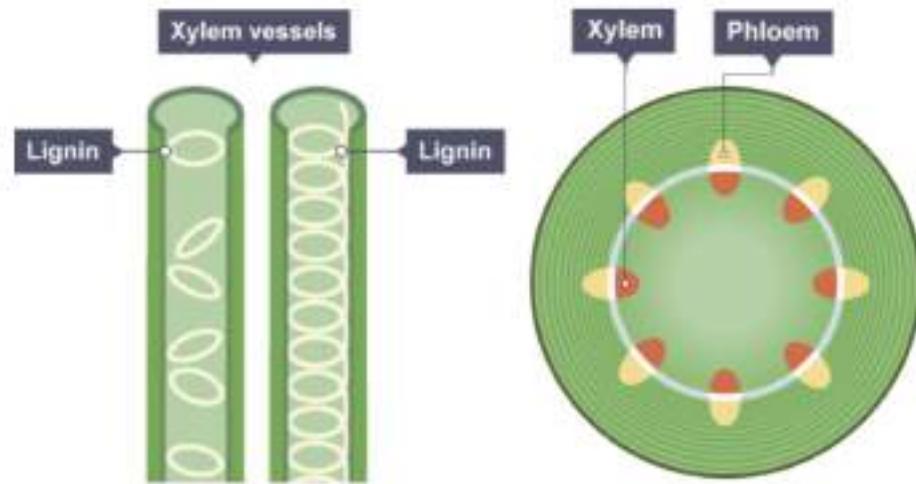
- Vascular plants are those which have specialized tissues for conducting *water, minerals and photosynthetic products* through the plant
- (nonvascular plants have simplified tissues and absorb water directly through osmosis through their cell walls)



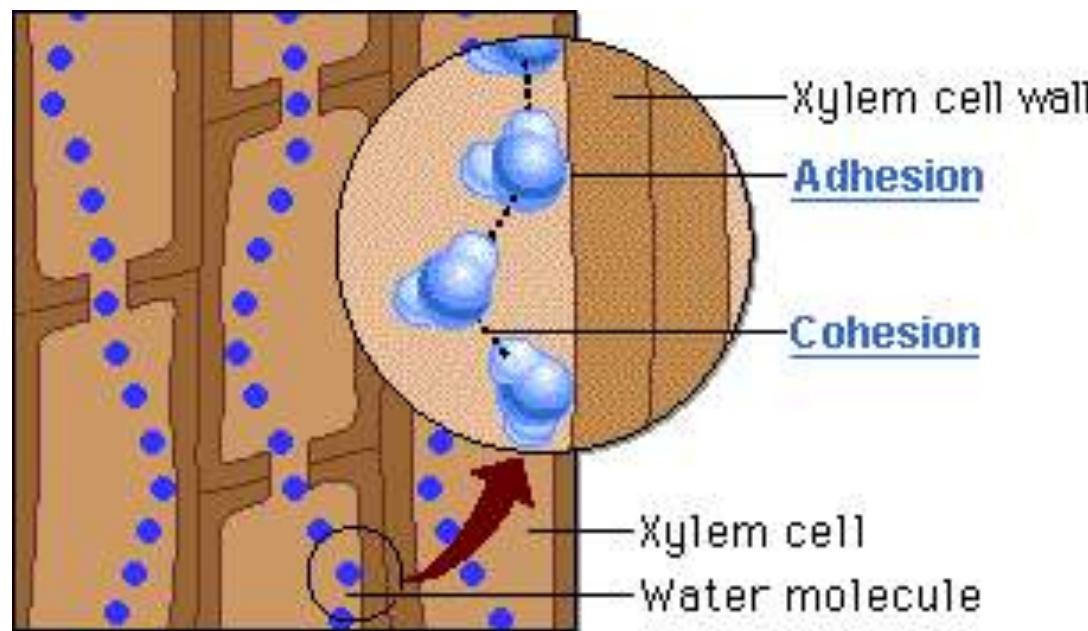
- In vascular plants, transport occurs due to vascular bundles that move water, mineral ions and sugars around the plant
- These vascular bundles consist of:
 - **Xylem:** transports water and nutrients from roots to leaves
 - **Phloem:** transports sugars produced from photosynthesis from leaves to roots
 - **Lignin:** provides strength and structure to plant

Plant Systems

Xylem, Phloem + Lignin



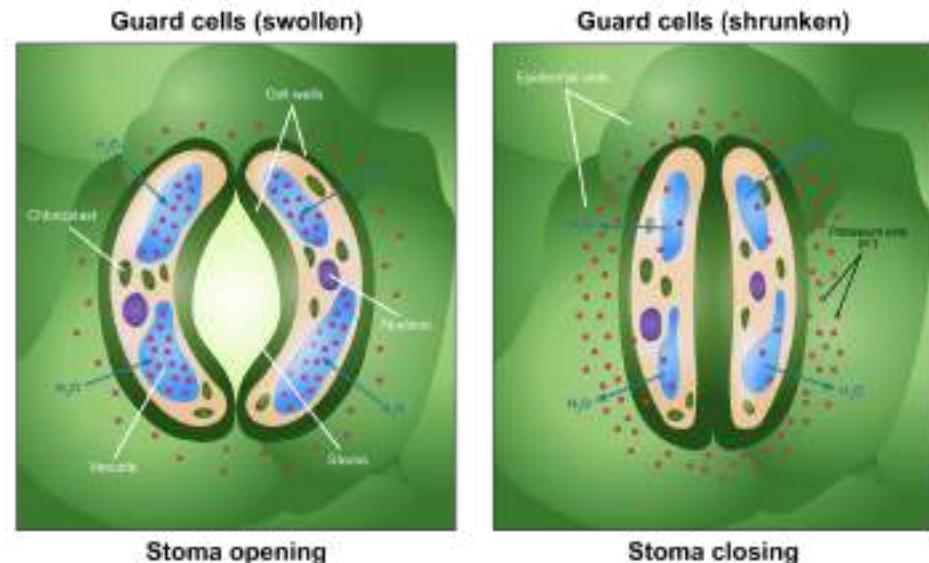
- Water is absorbed through the root hair cells
- The water is pulled up through the roots into the stem using...
COHESION
- It pulls the water up like a vacuum



Plant Systems

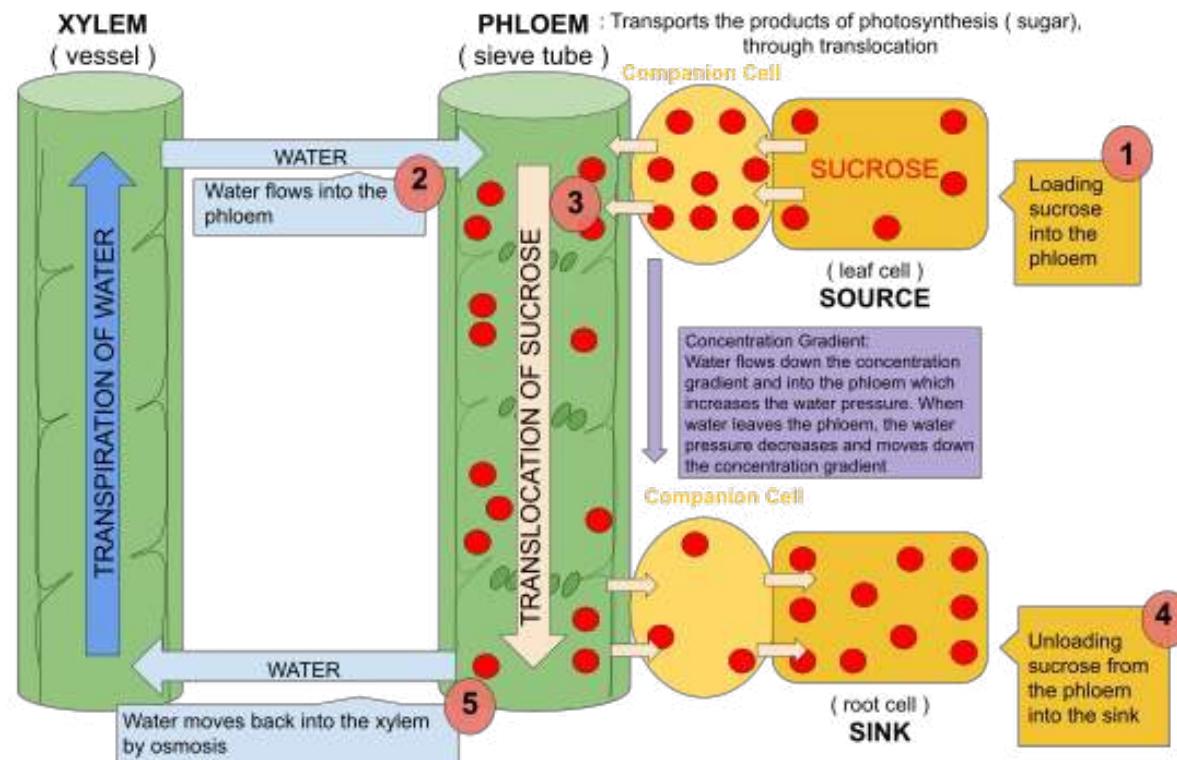
Stomata

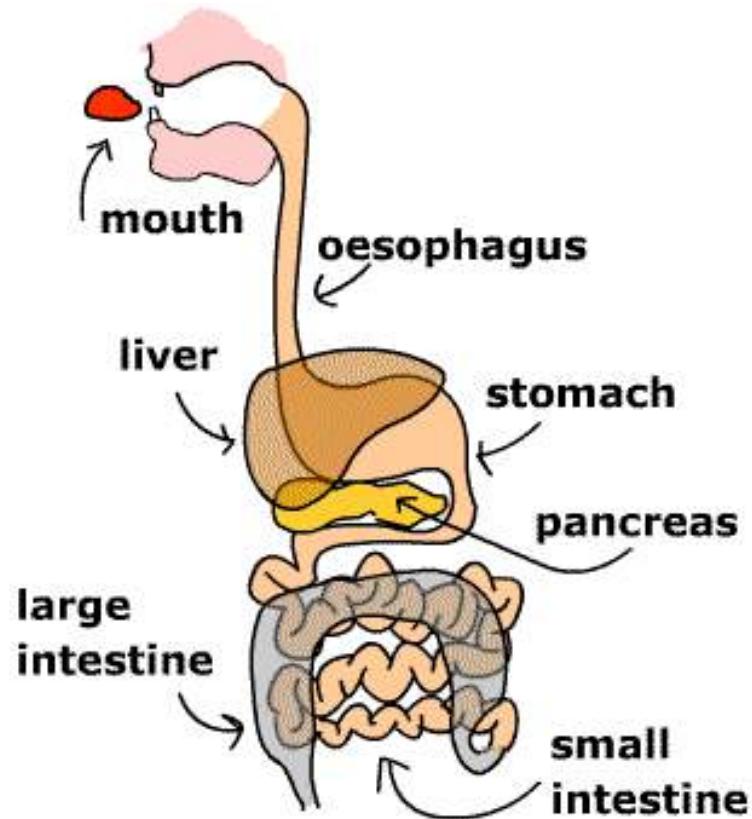
- When it reaches the leaves of the plant, water can exit through the stomata
- If the guard cells are full of water, they will open, letting water out
- If the guard cells are flaccid (not much water), they will close so no more water can leave the plant



- **HUMIDITY**
 - transpiration decreases when there is a lot of water vapour in the air
 - this reduces the water concentration between the leaves and air, so less water molecules evaporate
- **TEMPERATURE**
 - transpiration increases as temperature increases
 - this is because heat energy increases the rate of water evaporation
- **WIND**
 - as wind (air currents) increase, the rate of transpiration increases due to increasing the rate of water evaporation
- **TIME OF DAY**
 - the rate of transpiration decreases at night due to it being cooler and more humid

- Movement of sucrose from the leaves to the rest of the plant





- The purpose of the digestive system is to **obtain nutrients from food** by breaking it down
- **Digestion** is the breakdown of food into a form that can be used by an organism for metabolism (chemical processes)
- Digestion can occur due to **physical** and **chemical** mechanisms
- As mammals are heterotrophs, they require eating other organisms to obtain their nutrients. These nutrients are obtained from the breakdown of organisms

Specialised Cell: Villi

Tissue: Small intestine tissue

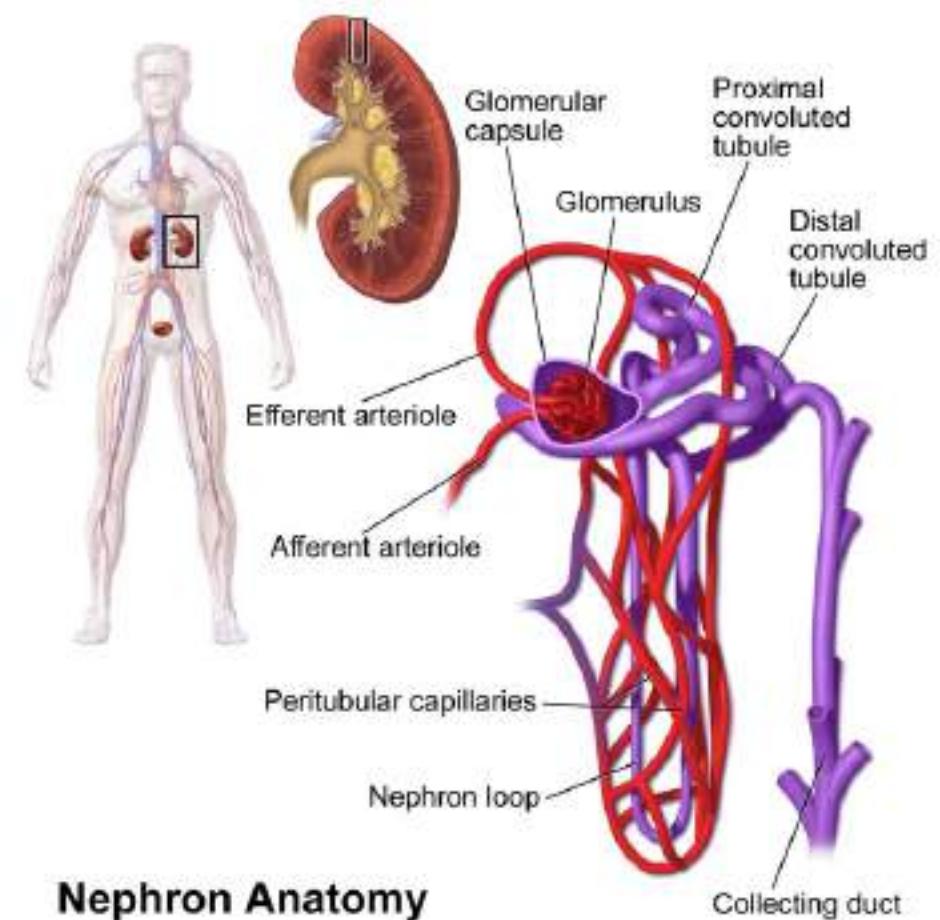
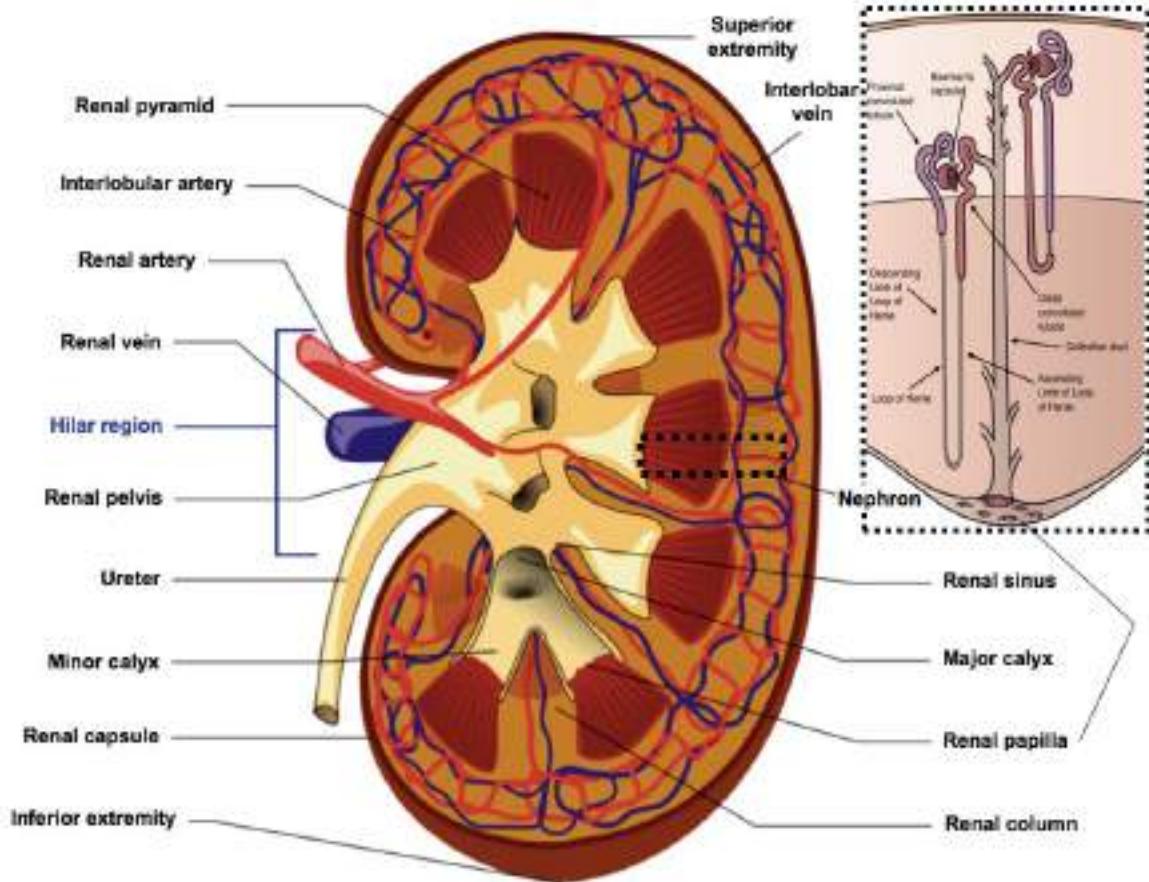
Organ: Small intestine

System: Digestive system

Organism: Humans!

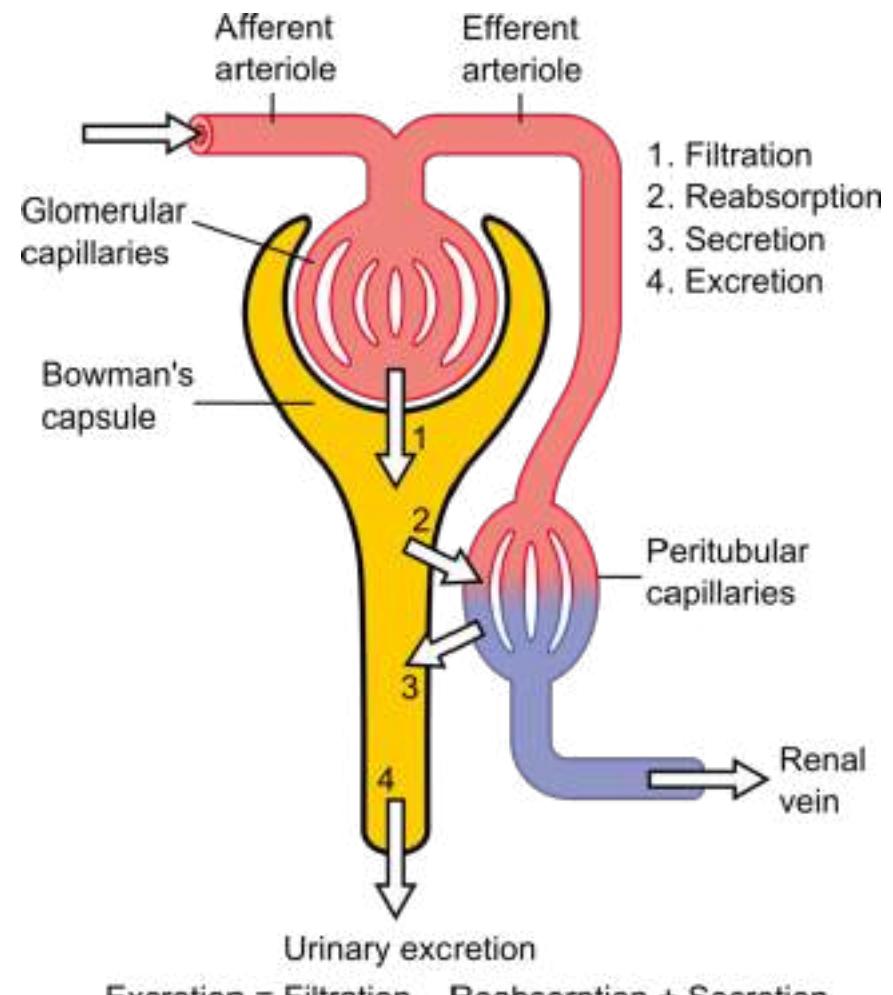
Animal Systems

How the Kidneys Work



Nephron Anatomy

- Each kidney is made up of subsections called *nephrons*
- Blood enters the kidney from the aorta (part of the circulatory system)
- It enters the *Bowman's capsule*, which filters out blood cells and proteins (only water and small molecules pass through)
- The solution (with water and small molecules) passes through tubing, where salts, glucose, amino acids and water is absorbed
- Everything that is not reabsorbed is excreted in urine



Specialised Cell: Nephrons

Tissue: Kidney tissue

Organ: Kidney

System: Excretory system

Organism: Humans!

- Glands are *organs* located around the body. Endocrine glands produce and store *hormones* for release into the *bloodstream*
- They regulate how much of each hormone is released, depending on the levels of hormones (or other substances) already present in the blood
- Things such as stress, infection and changes in fluid balance can affect hormone levels

Specialised Cell: Secretory epithelial cells

Tissue: Glandular tissue

Organ: Glands

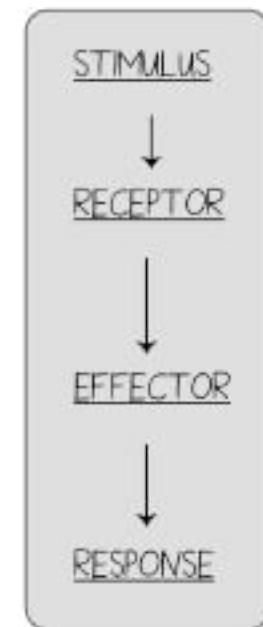
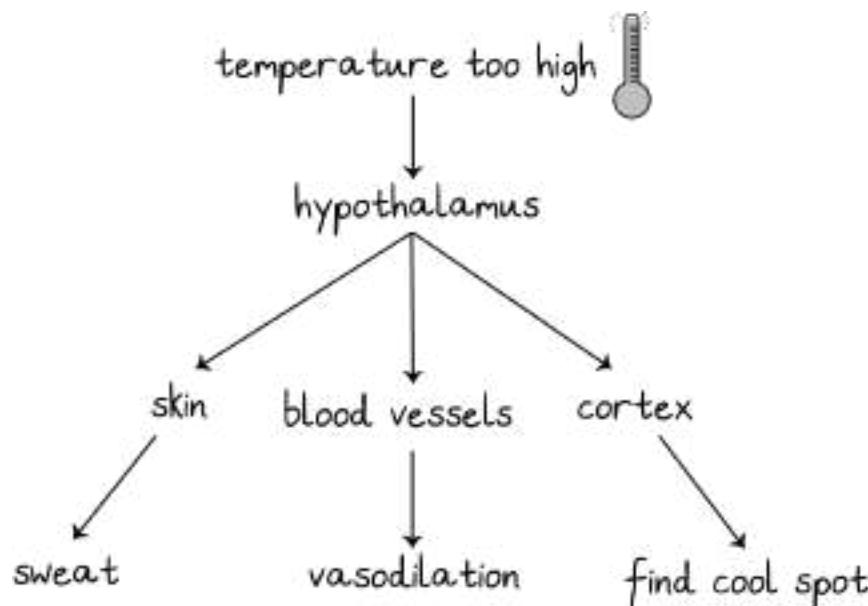
System: Endocrine system

Organism: Humans!

Homeostasis

Stimulus-response Model

- **Stimulus:** a change in the environment (either external or internal)
- **Receptor:** transform environmental stimuli into electrical nerve impulses
- Impulses are then transmitted via neurons to the **central nervous system**
- Signal is transmitted via neurons to effectors
- **Effectors:** organs that produce a response to a stimulus

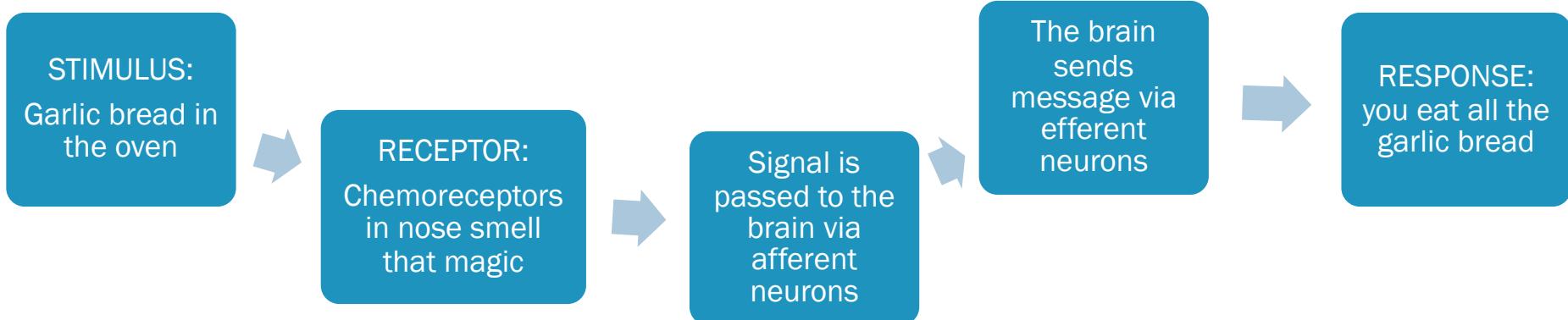


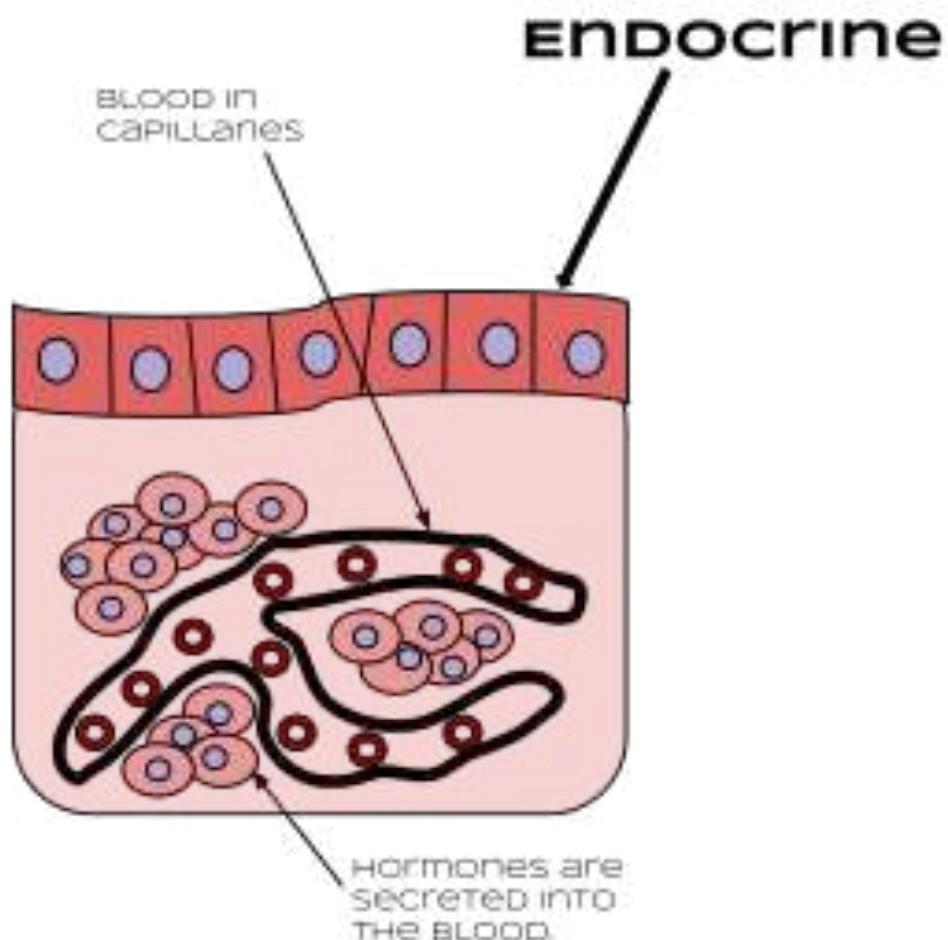
Homeostasis

Stimulus-response Model



The perfect candle doesn't exi-





Homeostasis

Ways of Controlling Homeostasis

Thermoregulation

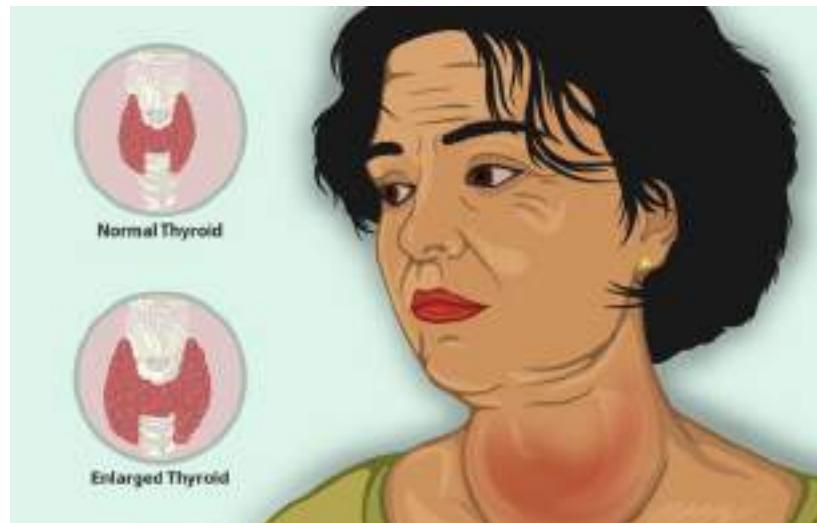
Water regulation
(osmoregulation)

Blood glucose
regulation

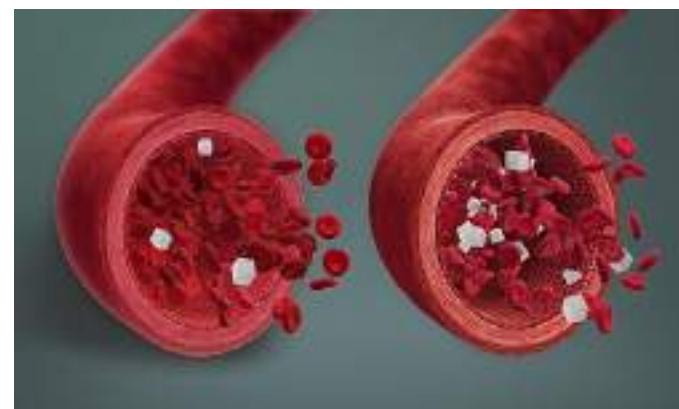
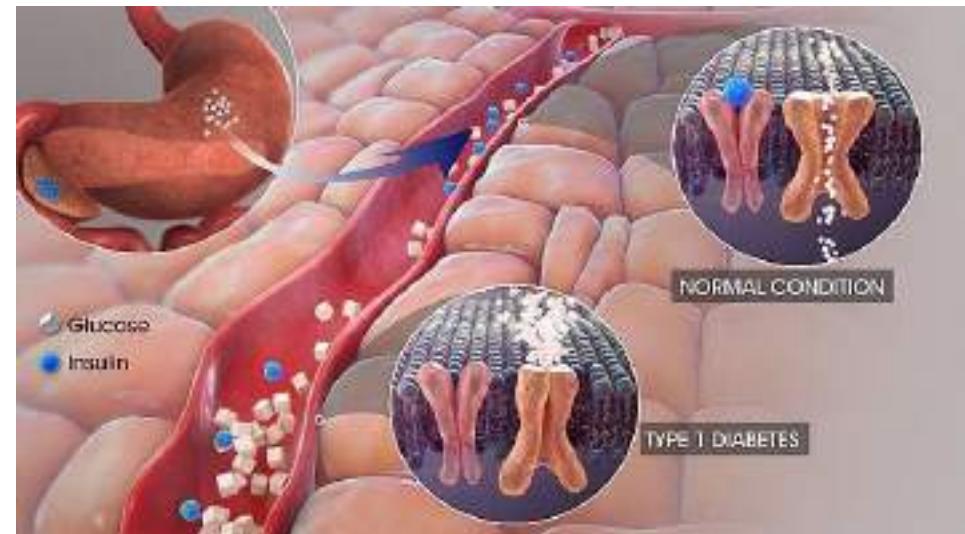
Homeostasis

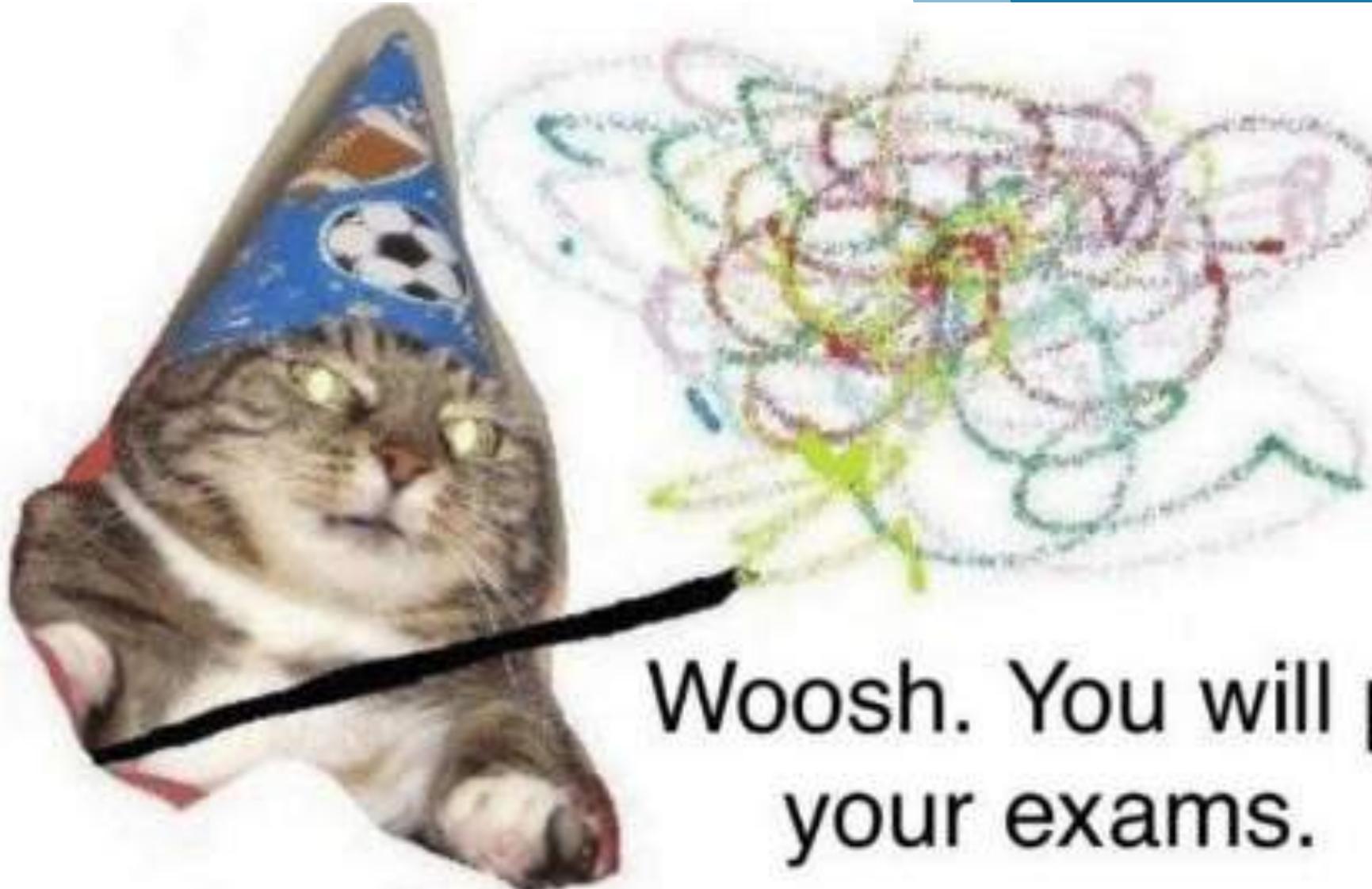
Homeostatic Malfunctions

overproduction of thyroxine



lack of insulin





Woosh. You will pass
your exams.